

AD-A054 037

ARINC RESEARCH CORP SANTA ANA CALIF WESTERN DIV
A SPECIFICATION FOR TACTICAL DATA SYSTEM COMPUTER PROGRAM DOCUM--ETC(U)
NOV 66 A M BARLOW, N J SCARLETT
414-04-5-693

F/G 9/2

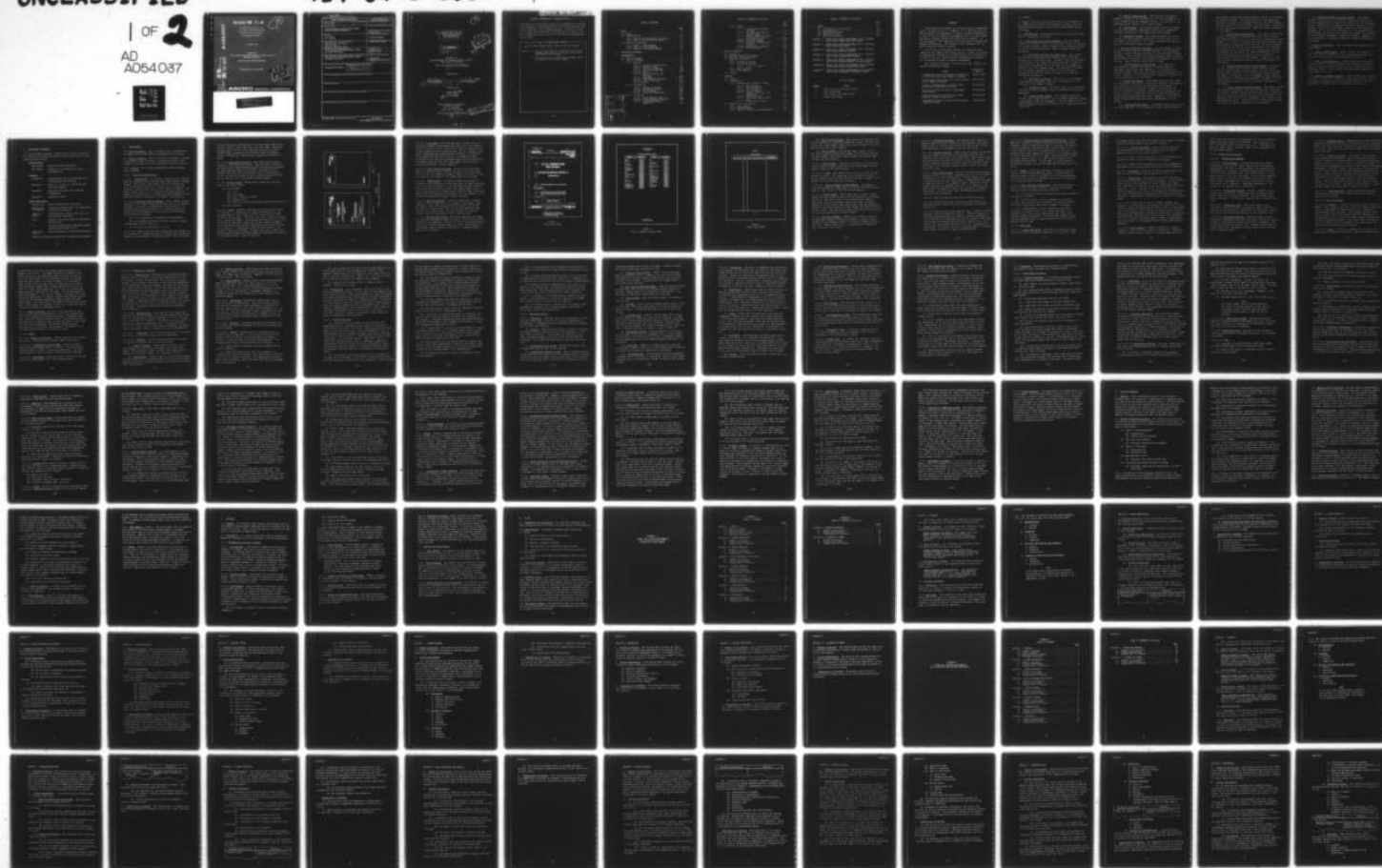
N123(61756)56869A

NL

UNCLASSIFIED

1 OF 2

AD
A054037



FOR FURTHER TRAN

A SPECIFICATION FOR
TACTICAL DATA SYSTEM
COMPUTER PROGRAM
DOCUMENTATION

November 1966

Prepared for
FLEET COMPUTER PROGRAMMING CENTER, PACIFIC
San Diego, California

Under Contract N123(61756)56869A

Publication No. 414-04-5-693

AD A 054037

AD No. _____
DDC FILE COPY



ARINC RESEARCH CORPORATION

This document has been approved
for public release and sale; its
distribution is unlimited.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 414-04-5-693✓	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A SPECIFICATION FOR TACTICAL DATA SYSTEM COMPUTER PROGRAM DOCUMENTATION		5. TYPE OF REPORT & PERIOD COVERED
7. AUTHOR(s) A.M. Barlow N.J. Scarlett		6. PERFORMING ORG. REPORT NUMBER 414-04-5-693
9. PERFORMING ORGANIZATION NAME AND ADDRESS ARINC Research Corporation✓ 2551 Riva Road Annapolis, Maryland 21401		8. CONTRACT OR GRANT NUMBER(s) N123(61756)56869A✓
11. CONTROLLING OFFICE NAME AND ADDRESS FLEET COMPUTER PROGRAMMING CENTER, PACIFIC San Diego, California		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) FLEET COMPUTER PROGRAMMING CENTER, PACIFIC San Diego, California		12. REPORT DATE November 1966
		13. NUMBER OF PAGES 81
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
16. DISTRIBUTION STATEMENT (of this Report) UNCLASSIFIED/UNLIMITED		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
<div style="border: 1px solid black; padding: 5px; display: inline-block;"> DISTRIBUTION STATEMENT A Approved for public release; Distribution Unlimited </div>		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)		

(7)

(6) A SPECIFICATION FOR
TACTICAL DATA SYSTEM
COMPUTER PROGRAM
DOCUMENTATION,

DDC
MAY 18 1978
RESOLVED
F

(11) Nov ~~1966~~
(12) 152 p.

Prepared for
FLEET COMPUTER PROGRAMMING CENTER, PACIFIC
San Diego, California

Under Contract N123(61756)56869A
(15)

Prepared by

(10) A. M. Barlow N. J. Scarlett N. J. Scarlett
A. M. Barlow N. J. Scarlett N. J. Scarlett

Approved by

W. C. Hanna
for W. C. Hanna

ARINC RESEARCH CORPORATION
Western Division
P. O. Box 1375
Santa Ana, California

Publication No. 414-04-5-693
(14)

This document has been approved
for public release and sale; its
distribution is unlimited.

406 547

SECURITY INFORMATION - CLASSIFICATION ()

Reproduction for non-military use of the information or illustrations contained in this publication is not permitted without the specific approval of the issuing activity. The policy for the use of classified publications is established for the U. S. Air Force in AFR 205-1, and for the U. S. Navy in Navy Regulations, Article 1509.

LIST OF CHANGED PAGES ISSUED

Insert latest changed pages; destroy superseded pages.

- Notes:
1. The portion of the text affected by the current change is indicated by a vertical line in the outer margins of the page.
 2. The asterisk (*) indicates pages changed, added or deleted by the current change.

TABLE OF CONTENTS

	<u>Page</u>
1. SCOPE	1-1
1.1 Scope	1-1
1.2 Classification	1-1
1.2.1 Type I, System Reference Documents	1-1
1.2.2 Type II, Operational Documents	1-2
1.3 Grades of Production	1-4
1.3.1 Grade 1, Final Manuals	1-4
1.3.2 Grade 2, Interim Manuals	1-4
1.3.3 Grade 3, Preliminary Manuals	1-4
2. APPLICABLE DOCUMENTS	2-1
3. REQUIREMENTS	3-1
3.1 Type I Documents	3-1
3.2 Type II Documents	3-1
3.2.1 Writing	3-1
3.2.1.1 Security Classification	3-1
3.2.1.2 Overall Content	3-2
3.2.1.3 Division of Manuals	3-8
3.2.1.4 Use of Illustrations	3-9
3.2.1.5 Tables	3-10
3.2.1.6 Notes, Cautions, and Warnings	3-10
3.2.1.7 References	3-10
3.2.1.8 Numbering and Headings	3-12
3.2.1.9 Level of Writing	3-14
3.2.1.10 Style	3-14
3.2.2 Illustrating	3-17
3.2.2.1 General Guidelines	3-17
3.2.2.2 Mechanical Details	3-19
3.2.2.3 Line Drawings	3-22
3.2.2.4 Sizing and Dimensions	3-23
3.2.3 Production	3-24
3.2.3.1 Final Manuals (Grade 1)	3-24
3.2.3.2 Interim Manuals (Grade 2)	3-29
3.2.3.3 Preliminary Manuals (Grade 3)	3-30

ACCESSION for	
NTIS	W Pa Section <input checked="" type="checkbox"/>
DDC	B If Section <input type="checkbox"/>
UNANNOUNCED	<input type="checkbox"/>
JUSTIFICATION	
BY	
DISTRIBUTION/AVAILABILITY CODES	
Dist.	AVAIL. and/or SPECIAL
A	

TABLE OF CONTENTS (Continued)

	<u>Page</u>
3.2.4 Changes	3-32
3.2.4.1 Configuration Changes	
Hardware	3-32
3.2.4.2 Configuration-Control	
Manual Changes	3-33
3.2.4.3 Manual Changes Not Under	
Configuration Control	3-33
3.2.4.4 Temporary Changes	3-33
3.2.4.5 Permanent Changes	3-35
3.2.4.6 Continuity of Numbering	
Systems	3-37
3.2.4.7 Supplements to Manuals	3-37
3.2.4.8 Revised Manuals	3-38
4. QUALITY ASSURANCE	4-1
4.1 General	4-1
4.2 Quality Program Requirements	4-1
4.3 Approval Control Authority	4-3
4.4 Approval Procedures	4-3
4.4.1 In-process Reviews	4-3
4.4.2 Preliminary Manuals	4-3
4.4.2.1 Letter of Approval	4-4
4.4.3 Interim Manuals	4-4
4.4.4 Final Manuals	4-5
4.5 Changes	4-5
5. DELIVERY	5-1
5.1 General	5-1
5.2 Preparation	5-1
5.2.1 Packaging and Packing of Manuals	5-1
5.2.1.1 With Hardware	5-1
5.2.1.2 Without Hardware	5-1
5.2.1.3 Bulk Shipment	5-1
5.2.1.4 Interim Manuals	5-2
5.2.1.5 Changes, Revisions, and	
Supplements	5-2
5.2.1.6 Manuscript Copy	5-2
5.2.1.7 Artwork and Reproducible	
Copy	5-2
5.2.1.8 Submittal for Record	5-3
5.3 Quantity and Distribution	5-3
5.3.1 Final Manuals	5-3
5.3.2 Interim Manuals	5-3
5.3.3 Changes, Revisions, and Supplements	5-3

TABLE OF CONTENTS (Continued)

		<u>Page</u>
6.	NOTES	6-1
6.1	Information for Contractors	6-1
6.2	Ordering Data	6-1
6.3	Reproduction Rights	6-1
6.4	Liability Notice	6-1
6.5	Publication Numbers	6-1
APPENDIX 1:	FORMAT AND CONTENT REQUIREMENTS FOR A TACTICAL DATA SYSTEM COMMAND AND STAFF MANUAL	
APPENDIX 2:	FORMAT AND CONTENT REQUIREMENTS FOR A TACTICAL DATA SYSTEM PLAN MANUAL	
APPENDIX 3:	FORMAT AND CONTENT REQUIREMENTS FOR A TACTICAL DATA SYSTEM OPERATION MANUAL	
APPENDIX 4:	FORMAT AND CONTENT REQUIREMENTS FOR A TACTICAL DATA SYSTEM PROGRAM DESIGN MANUAL	
APPENDIX 5:	FORMAT AND CONTENT REQUIREMENTS FOR A TACTICAL DATA SYSTEM PROGRAM ASSEMBLY LISTINGS MANUAL	
APPENDIX 6:	FORMAT AND CONTENT REQUIREMENTS FOR A TACTICAL DATA SYSTEM PROGRAM MAINTENANCE MANUAL	
APPENDIX 7:	FORMAT AND CONTENT REQUIREMENTS FOR A TACTICAL DATA SYSTEM PROGRAMMER'S REFERENCE MANUAL	

LIST OF FIGURES

<u>Number</u>	<u>Title</u>	<u>Page</u>
1	Front Cover and Back Cover Format	3-3
2	Title Page Format	3-5
3	List of Effective Pages Format	3-6
4	Change Page Format	3-7

FOREWORD

This document was prepared for the Fleet Computer Programming Center, Pacific, as part of a complete set of specifications for the procurement and management of computer programs documentation. As such it can be considered an integrated part of a total system approach to computer program development and procurement. In the development of this approach, it was necessary to prepare each package incrementally. The increments were integrated into the whole through an iterative process.

At the time of publication, several iterations have been completed, with inputs from various sources. However, the process of updating and refining this document should be a continuous one so that it will be a viable document incorporating all advances and evolutionary changes in computer programming.

The following documents, of which this is one, comprise the system documentation package:

<u>Title</u>	<u>Publication No.</u>
A Preparation Guide for Request for Quotation for Tactical Data System Computer Programs	414-04-1-689
A Procurement Specification for Tactical Data System Computer Programs	414-04-2-690
A Guide for Preparation of Tactical Data System Operational Specifications	414-04-3-691
Tactical Data System Computer Programming Specification	414-04-4-692
A Specification for Tactical Data System Computer Program Documentation	414-04-5-693
A Management Manual for Tactical Data System Computer Programs	414-04-6-694

1. SCOPE

1.1 Scope. This specification sets forth the requirements for the preparation, production, and updating of manuals and other documentation that support Tactical Data System (TDS) Computer Programs.

1.2 Classification. Documentation covered by this specification shall be categorized as follows.

1.2.1 Type I, System Reference Documents. Type I documents normally are prepared incident to the design, review, and delivery of a computer program. These documents are not usually intended for use by operating personnel. Type I documents include the following:

(1) Functional Description of Logic Flow. This document and the supporting program flow diagram provide a thorough description of the program logic. Together, they are the essence of the design of the computer program and provide a narrative (functional description) as well as visual (flow diagram) portrayal of the total program design. The functional flow chart for the computer program will be based on the Functional Description of Logic Flow after the design review has been successfully completed.

(2) Functional Flow Chart. This chart is a flow diagram using standard programming symbology to describe all of the functions in the computer program.

(3) Program Card Deck. This deck consists of the EAM cards on which the source language coding and comment cards were key-punched.

(4) Source Program Listing. This listing contains the history of the source program. It is a computer-generated listing, in programmer's (English) language, of all the elements of the Source Program and shows the structure of all program routines and subroutines.

(5) Object Program Listing. This listing is a computer-generated listing of the translation of the source program to the object program in machine language (binary). It shows all of the elements and the location of the object program.

(6) Test Routine. This testing routine causes the program to enter every possible combination of paths and to operate to the limits established in the operational specification.

(7) Simulation Program. This program consists of a set of routines with input data as statistically close to input of real performance as is possible. It is used to evaluate the effectiveness of the developed computer program.

1.2.2 Type II, Operational Documents. Type II documents are manuals which provide users with an understanding of the interaction between a computer program (software) and the associated equipment (hardware). These documents are used by operating forces, training and maintenance personnel, logic designers, programmers, and system analysts. Type II manuals include the following:

(1) System Command and Staff Manual. This manual is a non-technical, undetailed description of system functions, employment capabilities, and limitations. It provides senior officers, planners, and other users with a basic description of the system. Appendix 1 to this specification contains the format and content requirements for this manual.

(2) System Plan Manual. This manual contains a more technical and detailed description of the system functions, capabilities, and limitations than the System Command and Staff Manual. It provides functional information in depth to those persons who will be directly and personally involved with the system use, but is not intended to include the detailed information necessary for operating and maintaining the system. Appendix 2 to this specification contains the format and content requirements for this manual.

(3) System Operation Manual. This manual contains the details of system operation. It is intended for use by the personnel who

will actually operate the system equipment, and for the training of operator personnel. For airborne systems, this manual may parallel the content of the NATOPS Flight Crew Operations Manual, but shall describe system operation in greater detail. Appendix 3 to this specification contains the format and content requirement for this manual.

(4) System Program Design Manual. This manual contains the program flow diagrams, functional flow charts, and a narrative functional description of every routine in the systems operational program. It includes information concerning the functional interfaces between routines and subroutines and software and hardware. This manual is intended for use by programmers, logic designers, and system analysts. Should more than one operational program be developed for the system, its design documentation for each different program shall be contained within a separately identifiable system program design manual. Appendix 4 to this specification contains the format and content requirements for this manual.

(5) System Program Assembly Listings Manual. This manual contains the memory map, annotated source program listings, object program listings, core allocations, and any wired logic listings that relate only to the operational program routines. This manual is intended for use by programmers, logic designers, system analysts, and maintenance personnel. Appendix 5 to this specification contains the format and content requirements for this manual.

(6) System Program Maintenance Manual. This manual contains the program flow diagrams, functional descriptions, functional flow charts, assembly listings, and any wired logic listings for the test and utility routines associated with the system. This manual is intended for use by programmers, logic designers, and maintenance personnel. Appendix 6 to this specification contain the format and content requirements for this manual.

(7) System Programmer's Reference Manual. This manual contains a description of the system's computer and provides all of the programming instructions, rules, conventions, word formats, tables, illustrations, and examples required to prepare the source, assembly, object, test, maintenance, simulation, and interpreter programs. It also provides a description of the peripheral equipment pertinent to recording and loading the program. This manual is for use by system programmers, coders and trainees. Appendix 7 to this specification contains the format and content requirements for this manual.

1.3 Grades of Production. Type II documents are categorized into three grades.

1.3.1 Grade 1, Final Manuals. Grade 1 manuals are produced in final form and are intended for use by operating personnel. They are produced according to the requirements of 3.2.3.1.

1.3.2 Grade 2, Interim Manuals. Grade 2 manuals are delivered in advance of Grade 1 manuals to support early training or testing. They are produced only when required by the contract or when specifically ordered. Grade 2 manuals are produced according to the requirements of 3.2.3.2.

1.3.3 Grade 3, Preliminary Manuals. Grade 3 manuals are delivered in advance of Grade 1 or 2 manuals to enable the technical content and format of the manual to be reviewed and approved. They are produced in accordance with the requirements of 3.2.3.3.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on the date of invitation for bids, form a part of this specification to the extent specified herein.

Specifications

MIL-Q-9858A	Quality Program Requirements
MIL-N-17792	Negatives for Reproduction, General Preparation of

Standards

MIL-STD-12	Abbreviations for Use on Drawings and in Technical Type Publications
MIL-STD-15	Parts -1, -2, and -3. Electrical and Electronic Symbols
MIL-STD-16	Electrical and Electronic Reference Designations
MIL-STD-17	Mechanical Symbols

Other Publications

DOD Form 254	Security Requirements Check List
DOD Form 441 (Attachment)	Industrial Security Manual for Safeguarding Classified Information
GPO Style Manual	Revised Edition, January 1959, with 1962 Word Division Supplement
TDS---	Tactical Data System Computer Programming Specification
---	Official Classification Committee Uniform Freight Classification Rules
OPNAV INST. 5510.1C	Security Manual for Classified Information
Webster's Third New International Dictionary (Unabridged)	

3. REQUIREMENTS

3.1 Type I Documents. Type I documents shall be prepared in accordance with the TDS Computer Programming Specification.

3.2 Type II Documents. Type II documents, hereinafter referred to as manuals, shall be written, illustrated, produced, and changed in accordance with the requirements specified herein.

3.2.1 Writing. The following requirements concern writing type II manuals.

3.2.1.1 Security Classification.

3.2.1.1.1 Requirements. The security classification of manuals shall be designated by the Tactical Data System Computer Program Manager. The Security Requirements Check List, DD Form 254, which constitutes a part of the contract for all classified material, identifies and indicates the classified features. All pages, sheets, cards, etc., of classified documents shall be marked in accordance with the Industrial Security Manual for Safeguarding Classified Information (attachment to DD Form 441).

3.2.1.1.2 Additional Security Markings. When a manual contains information of a higher classification than that of the system or equipment it concerns, the appropriate classification of all classified data contained within or on that manual shall be identified by classification letters enclosed in parentheses and positioned as follows:

- (a) At the beginning of paragraphs and subparagraphs.
- (b) At the upper left and lower right corners of tables, illustrations, charts, cards, etc.
- (c) At the end of the subject or title.

3.2.1.1.2.1 Where the DD Form 254 has specified the document as not releasable to foreign nationals, the phrase "Special Handling Required - Not Releasable to Foreign Nationals" shall be placed

directly below the classification in 12 point Vogue bold capital letters, on Front Cover, Back Cover, and Title Page. Where space will not permit the use of the foregoing notation, the words "NOFORN" shall be substituted in 24 point Vogue bold capital letters, following the classification, separated therefrom by a hyphen.

3.2.1.1.3 Classification Letters. The classification letters assigned to the various levels are: (TS) Top Secret, (S) Secret, (C) Confidential, (CMH) Confidential-Modified Handling Authorized, and (CRD) Confidential-Restricted Data. Although it is not intended that every item of information bear a classification letter, the letter (U) shall be used to denote unclassified data when so directed by the TDS Computer Program Manager.

3.2.1.2 Overall Content. Manuals shall contain the following parts in the order listed:

- (1) Front matter.
 - (a) Cover.
 - (b) Title page.
 - (c) List of effective pages.
 - (d) Change record.
 - (e) Table of contents (including illustrations and tables).
- (2) Main contents.

3.2.1.2.1 Cover. Imprinted front and back covers shall be used. If the manual is classified, the highest classification of the contents shall be clearly marked at the top and bottom of both the front and back cover. The front cover shall contain the manual title, publication number, volume number and subtitle (if more than one volume is involved), credit line for the cognizant Command, and if classified, the security classification and security notice as in Figure 1a. If applicable, subtitles shall relate to the chapter content of the volume. The back cover shall contain only the publication number and volume number (if applicable) in addition to the classification. Figure 1b applies.

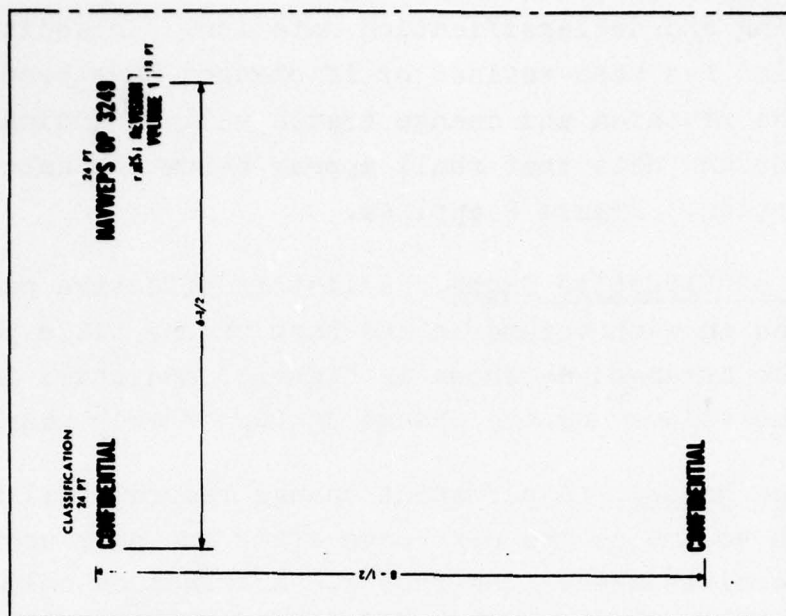


Figure 1b

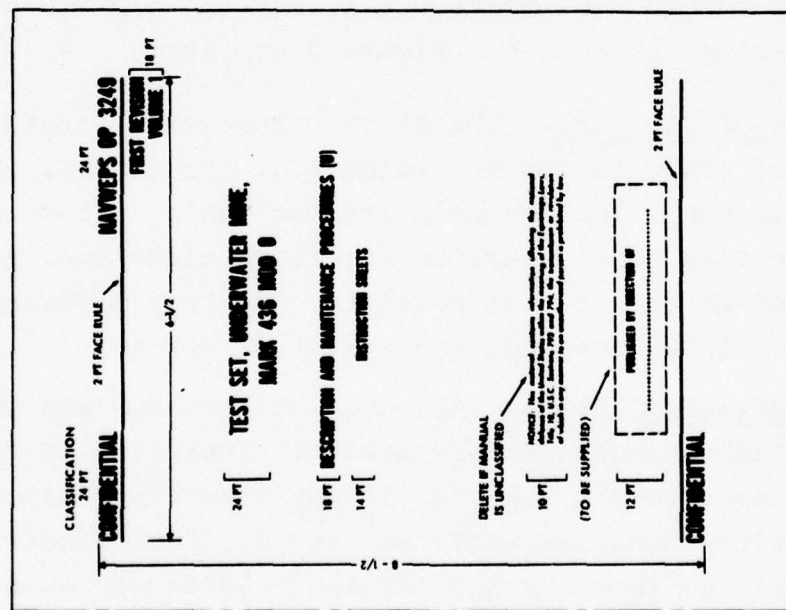


Figure 1a

FIGURE 1
FRONT COVER AND BACK COVER FORMAT

3.2.1.2.2 Title Page. The title page shall contain the title, publication number, volume number and subtitle (if more than one volume is involved), date of publication, and (if classified) the security classification, security notice, and the automatic time-phased downgrading and declassification notation. In addition, if the publication has been revised or if changes have been incorporated, the revision and change status will be indicated by the change number and date that shall appear below the date of original publication. Figure 2 applies.

3.2.1.2.3 List of Effective Pages. A list of effective pages shall be included in each volume on the back of the title page. The list shall be arranged as shown in Figure 3 and shall include every page in the volume and the change status of each page.

3.2.1.2.4 Change Record. A permanent change record shall be included in each volume as the next page after the page containing the list-of-effective-pages. The record shall include columns in which the following can be entered: the change number, title, short description of the change (copied from the change instruction sheet), date the change was incorporated, and the signature of the person incorporating the change. Figure 4 applies.

3.2.1.2.5 Table of Contents. The first volume shall contain a complete table of contents for all volumes of the manual. Each additional volume shall include only its own table of contents. The table of contents shall start on the first right-hand page following the change record. It shall include text division titles, a list of illustrations, and a list of tables.

(1) Text Division Titles. All section headings and primary and secondary sideheadings shall be listed. Inclusion of tertiary headings is not mandatory. However, if one tertiary sideheading is listed, all tertiary headings shall be listed. Subordination of sideheadings shall be shown by indentation. Paragraph numbers shall not be indented.

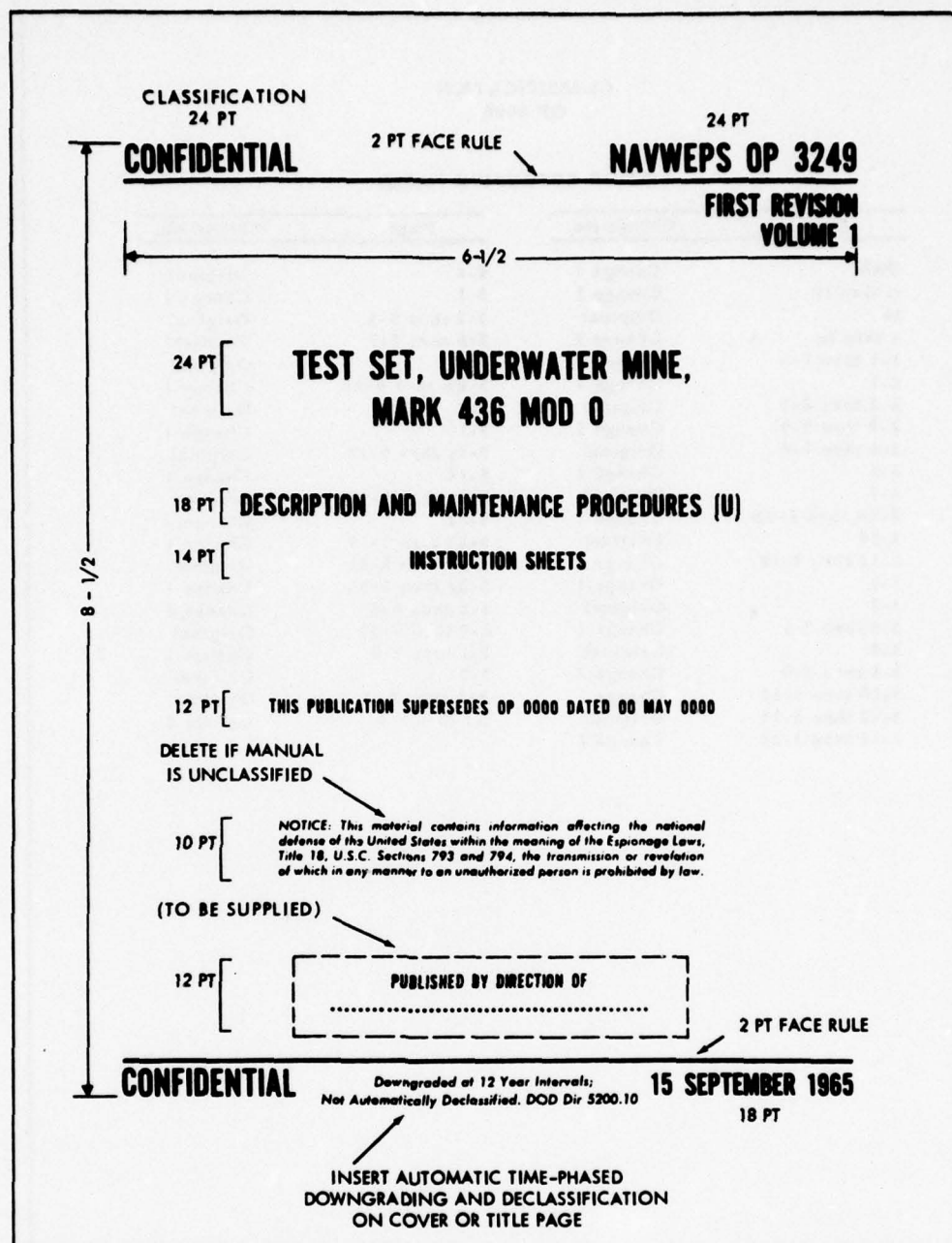


FIGURE 2
TITLE PAGE FORMAT

CLASSIFICATION
OF 0000

LIST OF EFFECTIVE PAGES

Page	Change No.	Page	Change No.
Title	Change 1	4-1	Original
ii thru iii	Change 1	5-1	Change 1
iv	Original	5-2 thru 5-5	Original
v thru ix	Change 1	5-6 thru 5-7	Change 1
1-1 thru 1-8	Change 1	5-8	Original
2-1	Change 1	5-8A thru 5-8B	Change 1
2-2 thru 2-3	Original	5-9	Original
2-4 thru 2-5	Change 1	5-10	Change 1
2-6 thru 2-7	Original	5-11 thru 5-13	Original
2-8	Change 1	5-14	Change 1
2-9	Original	5-15 thru 5-16	Original
2-9A thru 2-9B	Change 1	5-17	Change 2
2-10	Original	5-18 thru 5-19	Change 1
2-11 thru 2-18	Change 2	5-20 thru 5-21	Original
3-1	Change 1	5-22 thru 5-55	Change 1
3-2	Original	6-1 thru 6-8	Change 2
3-3 thru 3-6	Change 1	6-9 thru 6-39	Original
3-7	Original	7-1 thru 7-8	Change 1
3-8 thru 3-9	Change 2	7-9	Original
3-10 thru 3-11	Change 1	A-1 thru A-2	Original
3-12 thru 3-14	Original	I-1 thru I-3	Change 2
3-15 thru 3-22	Change 1		

ii
CLASSIFICATION

FIGURE 3
LIST OF EFFECTIVE PAGES FORMAT

CHANGE RECORD

Change Number	Date	Title and/or Brief Description	Signature of Validating Officer

iii

3-7

(2) List of Illustrations. Each volume shall include a list of the illustrations contained within that volume. The list shall include the figure number, exact title, and the number of the first page on which each figure appears.

(3) List of Tables. Each volume shall include a list of the tables contained within that volume. The list shall include the table number, exact title, and the number of the first page on which the table appears.

3.2.1.2.6 Main Contents. Appendices 1 through 7 to the specification contain the main content and format requirements for each manual covered by this specification.

3.2.1.2.6.1 Index. Each manual shall include an index following the main contents. The index shall list the manual's subject matter alphabetically and shall indicate the page or pages of the manual on which each subject is discussed.

3.2.1.2.6.2 Guide to Usage of System Manuals. Following the index to each manual, a page shall be included containing a statement of scope for each of the other system manuals.

3.2.1.2.7 Divider Pages. Tabbed pages shall be used to divide manual sections and may be used to divide subdivisions of information (e.g., functional level of troubleshooting and repair). Discretion should be used when using divider pages in smaller manuals to avoid having so many tabbed pages that their purpose is impaired--the purpose being to provide quicker and easier access to specific items. The tabs shall contain the pertinent section title, or a suitable description of subject matter.

3.2.1.3 Division of Manuals. Manuals are divided according to informational elements and physical elements. Manuals shall be divided into information elements to achieve the highest degree of usability. Manuals shall be divided physically for reasons of size, security, or user need.

3.2.1.3.1 Information Elements. The informational elements in manuals shall be section, subsection, and paragraph. Basically, manuals shall be divided into sections and then further divided into subsections and paragraphs within the subsections.

3.2.1.3.2 Physical Elements. Manuals shall be physically divided into two or more volumes when it is estimated that the final document will be more than 1-5/8 inches thick. When reasons other than size require physical division into two or more volumes, the reasons themselves determine at which places the contents shall be divided. In no instance, however, shall a volume be thicker than 1-5/8 inches.

3.2.1.4 Use of Illustrations. Text and illustrations (including diagrams, charts, etc.) shall complement each other to facilitate communication with the intended user. In some instances, an illustration shall be the primary means of communication and shall be supported by text. For example, whenever information is more clearly conveyed by a diagram, chart, etc., in conjunction with small blocks of explanatory text on the same sheet, it shall be so prepared. The text itself shall then merely reference the figure for that information.

3.2.1.4.1 Each illustration shall serve a definite purpose.

3.2.1.4.2 Illustrations shall satisfy the requirement of the approved document outline, and shall be prepared in accordance with 3.2.2.

3.2.1.4.3 When an illustration supports text, it shall be located adjacent to the text which references it. Effective balance of text and illustration shall be achieved. Physical appearance is not a criterion for determining text and art balance. Some topics require many illustrations and only a few lines of text. Conversely, but very seldom, much text with a few illustrations is appropriate. In general, the use of a greater number of illustrations results in better coverage and understanding.

3.2.1.4.3.1 Use and Location of Foldout Illustrations. Foldout pages are required for large illustrations and servicing block diagrams. Foldout illustrations shall be used when text relating to the illustration continues for more than one page, or the illustration is referred to in several places in the text. All foldouts shall have a page-width apron and the illustration shall be on the right-hand side of the page. The apron should contain any notes, tables, lists, etc., that directly relate to the accompanying illustration. If more space is required than is provided on the apron, one or more pages may be used on top of the apron.

3.2.1.5 Tables. Tables shall be used to present a series of related information and numerical values, to compare data for different types or sizes of equipment, to list the characteristics of specific pieces of equipment, and to list the positions of switches and other controls.

3.2.1.6 Notes, Cautions, and Warnings. Notes may be located before or after the action involved. Cautions and Warnings shall be located preceding the action involved.

(1) A note shall be used to emphasize an important operating procedure or condition.

(2) A caution shall be used to emphasize an operating procedure that if not strictly followed, or a condition that if not strictly maintained, may result in damage to equipment.

(3) A warning shall be used to emphasize an operation, procedure, or practice that if not strictly followed, or a condition that if not strictly maintained, may result in the injury or death of personnel. If both possible damage to equipment and possible injury or death of personnel are involved, a warning shall be used.

3.2.1.7 References.

3.2.1.7.1 Figures and Tables. References to figures and tables shall be specific according to number and, if in another volume

or element, made to the title and number of that volume or element. Captions and page numbers shall not be referenced.

3.2.1.7.1.1 Reference Placement. When a reference applies to one item within a sentence, the reference shall be placed immediately after the item being referenced.

3.2.1.7.1.2 When a reference applies to an entire sentence, the reference shall be placed at the end of the sentence.

3.2.1.7.1.3 When a reference applies to an entire paragraph or paragraphs, the reference shall be placed after the sideheading.

3.2.1.7.2 Paragraphs. Rules for paragraph referencing are the same as those for figures and tables given in 3.2.1.7.1.

3.2.1.7.3 Nomenclature. When assigned, official nomenclature for items and material shall be used throughout. The same nomenclature used in the text shall be used in figures and tables. Each item shall be identified by its full nomenclature when first mentioned. A short title may follow the official title to establish identity. If there is no possibility of misunderstanding, the shortened name or established abbreviation may be used thereafter. Nomenclature references shall be used in a consistent manner.

3.2.1.7.3.1 Consistency in the use of names, numerals, and symbols of all kinds shall be maintained, in both text and illustrations. Names and values used in the text and on illustrations shall be the same as those placarded on control panels and elsewhere on related equipment, and shall conform exactly in spelling, capitalization, and punctuation to that shown on the equipment. For other subjects, proprietary names or names of manufacturers shall not be used if an equivalent Federal Supply Catalog name is available.

3.2.1.7.4 Other Documents. Continual reference to outside documents reduces the effectiveness of instruction. Therefore, outside references shall be kept to a minimum commensurate with

need. Such need includes the requirements for cross-referencing between functions as part of the system. Text references to parts of a manual shall be spelled out in full, including words such as volume, chapter, section, figure, table, paragraph, and any publication numbers.

3.2.1.8 Numbering and Headings.

3.2.1.8.1 Informational Elements.

3.2.1.8.1.1 Major Elements. The major informational element for manuals is the section. Major elements shall be numbered sequentially from first to last according to the organizational requirements of the manual. The major-element heading shall be set off from the remainder of the text which follows it by being centered at the top of the first page. A major-element heading shall consist of the name of the element followed by a single Arabic number punctuated with a period followed by the title of the element, as in "SECTION 4. FUNCTIONAL DESCRIPTION." All letters of the heading shall be capitalized.

3.2.1.8.1.2 Section Subdivisions. Sections of manuals shall be divided into subsections. Subsections shall be numbered using Arabic numbers with decimal indenture. The first number shall denote the number of the section. Numbers shall be located flush left.

3.2.1.8.1.3 Subsection Titles. Subsections shall be given descriptive titles, following the subsection number; such titles shall be initial capitalized, underlined, and followed by a period. Text shall be started on the same line as the subsection title.

3.2.1.8.1.4 Subsection Divisions. Subsections may be further divided into paragraphs identified with Arabic numbers with decimal indenture. The first two numbers shall denote the number of the section and subsection, respectively. Paragraph numbers shall be located flush left. Paragraph text shall begin on the same line as the paragraph number.

3.2.1.8.1.5 Paragraph Titles. Paragraphs may be given descriptive titles; such titles shall begin on the same line as the paragraph number, and shall be initial capitalized, underlined, and followed by a period. Text shall be started on the same line as the paragraph title ends.

3.2.1.8.1.6 Figures and Tables. Photographs, line drawings, block diagrams, and schematics shall be identified by the word "figure" followed by the Arabic number of the major informational element in which the figure is located, a hyphen, and another Arabic number indicating the position of that figure in the sequence of figures in the major element. Tables shall be identified by the word "table" followed by the same numbering system used for figures. Figure titles shall contain initial-capitalized words, including the word "figure", and shall be located below the figure. Both the figure number and name shall be followed by periods. Table titles shall be written in all capital letters, including the word "table," and shall be located above the table. The table number and name shall be followed by periods.

3.2.1.8.1.7 Procedural Steps. Steps of procedures and other listings shall be numbered in sequence with Arabic numerals punctuated with periods.

3.2.1.8.2 Physical Elements.

3.2.1.8.2.1 Volumes. A "volume" is the major physical unit of manuals. When a manual consists of only one "volume," identification by volume number is superfluous, and the requirements of this paragraph shall not apply. When a manual consists of two or more volumes, each of the volumes shall be identified and distinguished by use of a different Arabic numeral starting with "1" and continuing as required. The volume number, preceded by the word "volume," shall be contained on the cover and on the title (or subtitle) page in each instance.

3.2.1.8.2.2 Pages. A "page" is a single side of a leaf of a manual when both sides are imprinted. Main content pages shall

be identified by the use of two Arabic numbers separated by a hyphen, as in "4-112." The number preceding the hyphen is the number of the major informational element of which the page is a part; the second number is the sequential position of the page among the other pages of the major element. All front matter pages, except the title page, shall be identified by the use of lower-case Roman numerals and a volume identifier, as in "4-ii," where "4" is the volume number and "ii" is the list of effective pages page which backs up the title page. This ruling applies to multivolume manuals. When only one volume is involved, the volume number and hyphen shall be omitted. Tabbed divider pages shall be identified and numbered separately from main content and front matter pages. The system used is the same as that for main content pages. Tabbed pages are numbered consecutively within each section in which more than one tabbed page is used.

3.2.1.9 Level of Writing. The level of writing shall be that which would be easily comprehended by a high school graduate who has received specialized technician training. In general, omit basic theory and simplify advanced theory. Specialized technical and engineering terminology shall be used only when no other terms will convey the information. Specialized terminology when utilized, shall be defined in the glossary of the manual, or in the subsection specified for definition of terms.

3.2.1.10 Style.

3.2.1.10.1 Manner of Expression. Wording shall be clear, specific, and factual. Sentences shall be short, simple, and direct.

3.2.1.10.1.1 Grammatical Person and Mode. Rules of accepted English usage and grammar shall be followed. The second person imperative shall be used in step-by-step procedures. The third person indicative shall be used for description and discussion.

3.2.1.10.1.2 Word Usage. Words used shall be apt as well as kept within the comprehension level of the intended reader.

3.2.1.10.2 Mechanics of Writing.

3.2.1.10.2.1 Abbreviations. Abbreviations, including acronyms, should be used in the text to facilitate expression, but not at the expense of reader comprehension. When first used in a discussion, the full name or word shall be used, followed immediately by the abbreviation within parentheses. The same form of abbreviation shall be used throughout. Well known quantities and values may be abbreviated without explanation; again the same form shall be used in every instance. MIL-STD-12, and the GPO Style Manual shall be the guides for abbreviation. Where conflict exists among these guides, the order of listing in this paragraph is the order of precedence. Nonstandard abbreviations may be used if the writer can justify their use on the basis of improving the utility of the document. Nonstandard abbreviations shall be capitalized in all instances.

3.2.1.10.2.2 Capitalization. Other than the rules established herein for titles and sideheads, the GPO Style Manual shall be the guide for capitalization along with MIL-STD's -12, -15, -16, and -17, in this order of precedence. In addition, the first letter of each word of official nomenclature shall be capitalized (when there is no conflict with a placard name on equipment), and names of parts and generic names of subunits shall not be capitalized.

3.2.1.10.2.3 Compounding. The GPO Style Manual shall be the guide for the use of prefixes, hyphens, and word compounding.

3.2.1.10.2.4 Numerals. The GPO Style Manual shall be the guide for the use of numerals, except for the following:

(1) Commas in Numbers. Commas shall be omitted in four-digit numbers but shall be used in numbers with five or more digits. When four-digit numbers are used in the same series or passage with five-digit numbers, the comma shall be used.

(2) Mixed Numbers. Numerals shall be used for mixed numbers. The whole number shall be separated from the fraction with a hyphen (unless the method of typesetting employs fractions as one letter), as in "9-1/2 inches."

(3) Number Adjectives. Number adjectives shall be written with a hyphen; however, if plus or minus values are used with the number, the hyphen shall be omitted. Examples: "28-volt switch," "-28 volt switch," "+28 volt switch."

(4) Binary Numbers. Numerals shall be used when discussing binary presentations, such as in "the output is a 1 or a 0." Where confusion may exist in determining whether "0" is to be interpreted as zero or oh, such as in an annotated source program listing, or in an illustration of programming language, i.e., JOC 00, the zeros shall be denoted by the slant sign as in the foregoing example.

3.2.1.10.2.5 Punctuation. The GPO Style Manual shall be the guide for the use of punctuation. When abbreviations, symbols, and reference designations require punctuation, precedence of authority shall involve, in the order listed, MIL-STD's, -12, -15, -16, and -17. The only exceptions to these requirements are when the punctuations used in the placarding of equipment differ, in which cases the equipment placarding shall be duplicated in the text and figures.

3.2.1.10.2.6 Spelling. The general authority for spelling shall be the 1962 Word Division Supplement to the GPO Style Manual, and the Style Manual.

3.2.1.10.2.7 Symbols. Symbols provide a shorthand method of identification of components. Used correctly, they reduce the volume of copy and provide a more understandable treatment. MIL-STD's -15 and -17 shall be followed, when applicable. The following rules shall be observed in the use of symbols:

(1) Symbols shall be used when full name designations are bulky or confusing.

(2) When using symbols other than those common to the technical field on an illustration, a key legend shall be included to give the full name of each part. The legend must be shown as part of the illustration, and in the same lettering used elsewhere on the illustration.

(3) Once a symbol has been selected, the identifying letter of the symbol shall be used throughout the document. When component symbols appear on the equipment, those symbols shall be used in text and illustrations. Symbols "C_L," "#," and "&" shall not be used in text unless they appear on the equipment.

(4) Capital letters shall be used to indicate shape.
Example: I-beam (not eye-beam).

3.2.2 Illustrating. The requirements that follow concern documenting information visually. All art work for final manuals shall be as specified herein. When interim manuals are urgently required and artwork preparation would delay delivery, artwork requirements specified herein may be relaxed to expedite delivery. Permission for such relaxation must be obtained from, and the lesser requirements for artwork preparation shall be coordinated with, the TDS Computer Program Manager or his representative. This relaxation of artwork requirements shall not carry over to the final-production version of a manual, the artwork of which shall still meet the requirements specified herein.

3.2.2.1 General Guidelines.

(1) Illustrations will normally contain essential and supporting details. Essential details consist of the subject matter and are reflected by the title. Supporting details include panels, arrows and center lines, location information, tools or hands showing action on essential elements, and details that give relative size, where necessary. Supporting details shall be made subordinate to the essential details. Detail which does not support the essential detail shall be eliminated. Examples of nonessentials which are prohibited include complicated or fancy shading which distorts, subdues, or diminishes essential detail, and background material which has no relationship to essential detail.

(2) Descriptive illustrations shall show the equipment or software as it would appear to an observer viewing it as a whole. For most descriptive illustrations, the viewpoint or camera position

selected shall be enough off center to give a clear perspective. Supports and extraneous objects should not be shown, except that in instances where location information is pertinent the surrounding should be shown in subdued tone.

(3) Illustrations portraying components or pieces of equipment that are relative in size shall be planned for consistency of presentation. As an example, all fullwidth chassis from a cabinet containing several full-width chassis should appear with the same width (uniform size). When illustrations are used to present hardware or software of related size, it is especially important that the callout and nomenclature requirements be established throughout before determining the uniform size.

(4) Drafting standards and graphical symbols shall conform to MIL-STD-12; MIL-STD-15-1, 15-2, and 15-3; MIL-STD-17; and the Tactical Data System Computer Programming specification.

(5) Callouts shall be used to show all symbol-part relationships that are used in the corresponding text.

(6) Nomenclature on illustrations shall be consistent with that in the text and both shall be consistent with markings on the equipment. Reference designations shall agree with MIL-STD-16, except when those marked on the equipment are different. In that case, equipment markings shall be used.

(7) A legend shall be provided on the illustration to explain each symbol shown unless it is a standard symbol being discussed in the related text or is well known. The use of keyed symbols shall be held to a minimum. All symbols used in illustrations shall correspond to those used in the text.

(8) Color should not be used, since under the lighting conditions of some ship compartments, it cannot be deciphered. When the use of color is deemed essential, its use must be approved by the TDS Computer Program Manager or his representative.

(9) Illustrations shall not contain the signature or mark of the originator.

(10) If an illustration can be equally well presented in a photograph or line drawing, the least expensive presentation shall be used.

(11) Cartoons and similar material shall not be used except to emphasize safety precautions more effectively. Permission to use cartoons must be obtained from the TDS Computer Program Manager.

(12) Simplification and organization are the goals in the layout of all illustrations. Crossovers and doglegs in wiring shall be avoided. The illustrations shall not be crowded. Sufficient white space must be maintained to ensure legibility.

(13) A complete set of artwork shall be submitted for each manual. If an illustration is used more than once at the same size, as many pieces of artwork shall be supplied.

(14) All artwork shall be prepared with line weights, line separations, callouts, etc., distinct enough to avoid loss of detail when reduced to 35-mm microfilm.

3.2.2.2 Mechanical Details.

3.2.2.2.1 Materials. Materials used in the preparation of final halftone artwork shall conform to the general requirements of MIL-STD-218-2. Diagrams and other line artwork shall be prepared using rolled linen technique.

(1) Artboard. Halftone artwork shall be produced or mounted on artboard equal to 3-ply Hurlock or 2-ply Strathmore. A cold white stock is required. Artwork shall be mounted by the hot-press dry-mounting method in a flat, secure, and wrinkle-free assemblage. All foldout artboards shall be one piece and splice free.

(2) Rendering Material, Linen. K&E Phoenix tracing cloth or equivalent shall be used for all linework.

(3) Tissue Paper Protective Sheet. White, 18-pound substance tissue paper shall be attached over each finished piece of halftone artwork and shall be trimmed flush on three edges of the artboard. This protective sheet shall be secured on the back and at the top

beneath the hinged flap of heavy cover paper. Vellum or similar oil or wax treated paper shall not be used.

(4) Protective Flap or Cover. Kraft, 60-pound substance paper or equivalent, shall be hinged at the top of the artboard, with sufficient overlap to remain firmly affixed when secured to the back of the artboard. The paper shall be trimmed flush on three edges of the artboard.

(5) Hot-Press Dry Mounting Tissue. Kodak dry mounting tissue, or equivalent, shall be used for mounting halftone artwork on artboard. Margins shall be as specified in MIL-STD-218-2. Artwork shall be absolutely wrinkle-free after mounting.

(6) Rubber Cement. Best Test Rubber Cement, or equivalent, shall be used.

(7) Overlays. Clear cellulose acetate sheets, gelatin coated on both sides, 0.005-inch thick, shall be used as an overlay for halftone artwork. Cellophane tapes shall be used to attach the overlay.

(8) Airbrush Colors. Neutral, retouch grays shall be used for all graphic art areas where gray tone is required. An opaque matte (dull finish) black and white should be used for mixing with the grays, when necessary, and for retouching. Airbrush color shall be of such quality that surfaces developed with it shall not fade or discolor with age, be coarse or rough, or flake off.

(9) Photographic Bleach. Chemical bleaches are acceptable only for minor corrections on photographic art, if areas treated by the bleach do not discolor from its use. Recommended bleaches are K&E Erasing Fluid No. 3028, Eastman Kodagraph Eradicator, or equivalent.

(10) Black Ink. Higgins or Pelikan waterproof black ink, or equivalent, shall be used for all line artwork where ink quality definition is necessary for reproduction requirements.

(11) Cellophane Tape. Scotch pressure-sensitive transparent cellophane tape, 1-inch wide, or equivalent, shall be used to make a hinge at the top to attach the overlay in position over halftone artwork.

3.2.2.2.2 Preparation. The skill of workmanship and the validity of techniques, in conjunction with the quality of materials, must create artwork that is easily and highly reproducible in the form intended. Within this requirement, illustrations shall be prepared by the most economical methods that will result in clearness and legibility. Lack of a high degree of usability shall be cause for rejection. Maximum use shall be made of engineering drawings (schematics, functional, and logic diagrams), whenever possible.

(1) Nomenclature. Nomenclature shall be uniform in size and spacing, mechanically lettered, clear, and absolutely legible. For halftone art, nomenclature shall be on a transparent acetate overlay. If nomenclature is mechanically lettered or preprinted on paper, the paper shall be trimmed neatly and parallel to the nomenclature. In no case shall nomenclature be placed within the area of the subject. Nomenclature with long arrows shall not be used to frame an illustration. Nomenclature shall be neatly located just far enough from the subject for clear separation.

(2) Arrows. Arrows shall be preprinted on self-adhering transparent material and shall contain a white shadow adjacent to the leader and arrowhead. They shall be trimmed neatly and close to the leader and arrowhead. They shall be burnished down to the overlay or artboard to prevent picking up, casting shadows, or creating false lines on the illustration. Arrows shall be straight and lead the reader's eye directly to the subject called out.

(3) Crop Marks. Crop marks shall be neatly placed at the corners of the border on the original reproducible art. Crop marks shall be indicated by four sets of approximately 3/8-inch marks drawn with a No. 1 Leroy pen. Crop marks shall not be joined at the corners, but shall start at a point approximately 1/4 inch away from each corner intersection. Lettering or callouts that form a part of the illustration shall be within the crop marks.

(4) Borders. Unless otherwise specified, borders shall not be shown on illustrations.

(5) Security Classification. Artwork shall be marked bottom center, front, and back, and each kraft cover shall be marked at the top and bottom center with the proper security classification. The downgrading notice shall be placed on the front of the board near the bottom classification. Line art on linen shall bear the appropriate classification in the upper left and lower right corners of the page.

(6) Marking and Identification. The following information shall be placed on the lower right hand corner of each illustration: the figure number, publication number, and, whenever the document consists of more than one volume or physical unit, the number of the volume to which the illustration belongs. Title blocks and other means of identification shall not appear in the image area.

3.2.2.3 Line Drawings. Line illustrations shall conform to the established styles and weights set forth in the following paragraphs. Where more than one alternative is offered, one shall be selected and its use shall be consistent throughout the document.

3.2.2.3.1 Three-Dimensional Views. Three-dimensional views shall be laid out as trimetric projections using 15-/30-degree base lines and standard foreshorten scales in length, height, and depth. All three-dimensional views shall be shaded bottom and right by a heavier line.

3.2.2.3.2 Orthographic Views. Orthographic drawings shall be used where no additional clarity is gained through the use of photographs or three-dimensional drawings.

3.2.2.3.3 Cutaway Views. All cutaway line drawings, including three-dimensional and orthographic views, shall have a mechanical shading pattern, or patterns, as appropriate. Dotted or line patterns may be used. Methods and patterns of shading for cut surfaces shall be consistent on all line drawing cutaway views within the same document.

3.2.2.3.4 Flow Diagrams and Charts. Program flow diagrams and functional flow charts shall be prepared in accordance with the TDS Computer Programming Specification.

3.2.2.4 Sizing and Dimensions. Wherever possible, all art shall be prepared in a 2 to 1 oversize ratio of its final reproduction size. Only one ratio shall be used in publication or series of publications. When planning artwork, illustrations that are less than full-page height shall be condensed to half-page height if it is possible to do so and still either retain a full-page width or reduce the width (along with the height) to full-column width. Primary consideration shall be given to resolving the opposing requirements of obtaining adequate size for clear presentation (including reduction to 35-mm microfilm) and of keeping size to a minimum to conserve space and reduce bulk in the handbook.

(1) Column-width illustrations, including nomenclature, shall occupy the full-width of a printed column. Normally, page-width illustrations shall occupy the full width of a printed page.

(2) Arrows shall be uniform in size within any handbook or volumes thereof.

(3) On the original size artwork, the nomenclature callouts must approximate 12- or 14-point type in size and width of letter line. Nomenclature shall be planned to reduce to a size between 8- and 10-point type and be consistent within the manual. When necessary, 6-point type is permissible as a final reduced size on large wiring diagrams and schematics.

(4) Only one reproduction size dimension (in inches) shall be given on the reproducible; this is the significant one of the illustration's vertical or horizontal dimensions. A reproducible illustration of a single page or less shall have its reproduction size marked between the horizontal crop marks on the bottom margin.

(5) Machine generated printouts, such as Program Assembly Listings, shall be photo reduced to 8-1/2- by 11-inch page size for incorporation into manuals.

3.2.3 Production. Requirements concerning the composition and reproduction of Type II manuals are contained herein.

3.2.3.1 Final Manuals (Grade 1).

3.2.3.1.1 General Guidelines. The following requirements constitute good composition makeup and shall be complied with:

(1) Each chapter, and section within a chapter, shall start on a right-hand page.

(2) All right-hand pages shall be paginated with odd numbers. Foldout pages (printed on a right-hand page only) shall carry two page numbers.

(3) A right-hand page shall never be left blank.

(4) A page shall never begin or end with a widow line.

(5) A page shall never begin or end with a hyphenated word.

(6) Except for carryover, if any text is placed on a page, five lines of text shall be the minimum.

(7) Columns on facing pages shall end on the same line except when a page is the last one of a section and falls short.

(8) Text and illustrations shall be laid out compactly to avoid blank space.

(9) Illustrations shall be shown in copy as close to the first reference as possible, except that foldout illustrations should be planned for placement at the end of a section. Art shall not be shown in advance of its reference if a page has to be turned to read the first reference to the art. Page heading and foot information for illustration pages shall follow the same format as for text pages.

(10) Illustrations requiring more than one page shall carry an identical figure number and caption of each page along with a parenthetical sheet reference.

(11) Illustrations requiring a foldout page shall be printed on a right-hand page and shall have the same type of heading and foot information as a full-page illustration. The caption shall

be held to the extreme right of the illustration. The right-hand trim shall be the same as a single page, and the left-hand trim shall allow an extra 1/4 inch for apron width. If explanatory notes appear on the illustration, they shall be contained inside the apron area or on pages immediately preceding the apron. The running head shall not extend into the apron area.

3.2.3.1.2 Composition. It is not the intent of this specification to state the different methods of composition or composing equipment to be used, but rather to state the results required. All handbooks are subject to 35-mm microfilming. Letters, lines, and symbols shall be of a uniform contrast throughout. Blurred or smudged printing or drop-out of characters or lines shall be cause for rejection. Characters shall be no smaller than 8-point type with the exception that the smallest characters on large schematic diagrams may be equal to 6-point type. When revisions are made, typography shall conform to that of the original; exceptions may be allowed to this requirement but must be approved by the TDS Computer Program Manager.

3.2.3.1.2.1 Cold-Type Composition. Pages should be prepared for back-to-back printing by the offset process. Masters should be oversize to allow for 20-percent photo-reduction to final printed size. Master plates may be prepared by typing directly on them or by transferring reproducible copy to them by Xerox, Ektalith photolithographic negative, or similar processes. Copy should be composed with an IBM Boldface No. 1, or equivalent, typewriter having a typeface suitable for 20-percent photo-reduction to final printed size (no smaller than 8-point type for body text). Type composition for security markings shall be at least 4 points larger than the body text.

3.2.3.1.2.1.1 Running Heads and Feet. Each page, except the title page, shall have running heads and feet. Content and placement are as follows:

- (1) The reference designation number of the equipment or system being covered is in the upper inside corner. On the

line directly below is the name of the chapter (such as "Front Matter," etc.).

(2) The security classification shall be centered at both the bottom and top of the page. Also centered at the top of the page and directly below the security classification shall be the short title of the manual (the official number).

(3) The word "Paragraph," "Figure," or "Table" (as applicable), followed by the number of the applicable item that starts the page, shall be in the upper outside corner. For front matter pages, the name of the page is in this location.

(4) The name of the issue ("ORIGINAL," "CHANGE 1," etc.) shall be in the lower inside corner.

(5) The page number shall be in the lower outside corner.

NOTE

For foldout pages, copy for running heads and feet shall be located similarly, except that all items shall extend beyond the apron and shall be exposed when the page is folded as well as unfolded.

3.2.3.1.2.1.2 Tabbed Divider Pages. The most expeditious method of composing tabbed divider pages may be used, providing the final results are in keeping with the appearance, quality, and utility of the rest of the manual.

3.2.3.1.3 Reproducible Copy. Reproducible copy provided to procuring activity shall be prepared according to the following requirements.

3.2.3.1.3.1 Text.

(1) Copy shall be typed on a white, hard-finish paper. Preprinted format pages of this quality may be used.

(2) Black carbon ribbon, or equivalent, shall be used in machines for copy typing.

(3) Text copy typed on plain white, hard-finish paper shall be fastened down on preprint makeup pages with rubber cement or white Scotch tape, or equivalent.

(4) Page size shall be rectangular, 8-1/2 by 11 inches.

(5) Line spacing shall be 1-1/2 spaces between lines of text in a paragraph.

(6) Image area shall be 9-1/2 by 6-1/2 inches.

3.2.3.1.3.2 Illustrations. Reproducible copy for illustrations shall be as follows:

(1) Final-sized, screened, positive photoprints of the original continuous tone artwork shall be furnished. The screen used shall be from 100 to 120 lines, final size.

(2) A reproducible photocopy of original line illustrations shall be supplied.

(3) Photoprints of illustrations (line and screened halftone artwork) shall be affixed to the reproduction page with rubber cement or white Scotch tape, or equivalent.

(4) When the size of foldouts is so large that reproduction by offset press is not practical, these foldouts may be prepared by the ozalid process. All ozalid reproductions must be legible and contain a minimum amount of background.

3.2.3.1.3.3 Combination Illustrations. Combination illustrations require special handling. The photoprint of the line artwork shall be permanently attached to the reproduction page, and the halftone print shall be permanently attached to the line artwork print.

3.2.3.1.3.4 Ruled Illustrations and Tables. Illustrations shall not be box-ruled around the outside. Tables shall be ruled when necessary to clarify the presentation and to separate them from surrounding text or illustrations. Vertical ruling on tables shall be used only when it adds to the clarity of the presentation.

3.2.3.1.3.5 Figure Titles. Figure titles shall be imprinted directly on or mortised into the reproduction page.

3.2.3.1.4 Negatives. When negatives are contracted for, all requirements of Specification MIL-N-17792 (AER) shall govern. The production of negatives from reproducible copy must be authorized by Government Printing Office Waiver 69806, as cited in the contract.

3.2.3.1.5 Tabbed Divider Pages. Tabbed pages shall be prepared for each instance specified in the manuscript copy according to the following practices:

(1) Rectangular page size is the same as for other pages (8-1/2 by 11 inches).

(2) Tabs shall extend 3/8 inch beyond the outer vertical edge of the page, be 2-1/4 inches long, be die cut, and have rounded corners. Positions of the tabs along the vertical edge shall vary from top to bottom. The selection of tab position for imprinting shall be determined by the position of the preceding tab in the volume (not the chapter), the first tabbed page in the volume having a top-of-the-page position and proceeding accordingly to the bottom and back to the top again, as required.

(3) Tabs shall be imprinted on both sides according to manuscript copy requirements. Abbreviations shall be allowed when necessary because of space restrictions.

3.2.3.1.6 Binding. Manuals shall be bound in looseleaf form to facilitate the insertion of replacement pages. Commercial metal-type fasteners shall be used; pages shall be punched or drilled as follows (all dimensions are in inches):

- (1) Number of holes: 3
- (2) Hole size: 1/4 inch
- (3) Distance, center to center: 4-1/4 inch
- (4) Distance to binding edge: 7/16 inch

3.2.3.1.7 Covers. Plastic or pressboard cover stock may be used. Covers for CONFIDENTIAL manuals shall be red; covers for SECRET

and TOP SECRET shall be yellow; covers for UNCLASSIFIED manuals shall be gray. When a manual comprises two or more volumes, the volume number and subtitle shall be imprinted on the cover of each volume beneath the "nomenclature of equipment (or system)." Cover size shall be 9 by 11 inches, flush to the binding edge.

3.2.3.1.8 Paper Stock. Paper stock requirements shall be as follows:

(1) Material prepared for Grade 1 manuals shall be final printed on 60-pound book paper that is free of background material or discoloring that would be reproduced photographically. The paper shall be a bright white, of such opacity that reverse-side markings shall not project through, and that a clear, sharp photographic image of the copy can be obtained.

(2) Paper stock for foldout pages shall be plain white, erasable, plastic printing paper, and shall have a substance weight of not less than 80 pounds per 500 sheets, basis 25 by 38 inches.

(3) Paper stock for tabbed divider pages shall be plain white card having a substance weight of 220 pounds per 1000 sheets, basis 25-1/2 by 30-1/2 inches.

3.2.3.2 Interim Manuals (Grade 2). An interim manual is a corrected or improved (if necessary) version of a preliminary manual, reproduced in quantity to meet early training or operational test requirements. Also, interim manuals shall be provided to meet the technical manual requirements for developmental systems and equipments. Standards of typography, layout, and artwork for interim manuals shall be the same as those specified for preliminary manuals in paragraph 3.2.3.3 except for the following:

(1) Any changes and additions resulting from the review of the preliminary manual by the Approval Control Authority or its representative shall be incorporated in the first issue of the interim manual. Thus, the first issue of the interim manual shall

consist of a combination of "original" and "change 1" pages in order to use as much of the prior production effort for the preliminary manual as is possible.

(2) The interim manual shall have a "list of effective pages" page and a "change record" page in the front matter of each volume.

(3) The contractor shall supply either the printed and bound copies, in the required quantity, of the interim manual, or the reproducible copy for the same as required by the contract.

(4) Reproducible copy and methods shall be such as to provide for a good and lasting fidelity of reproduction for the entire run of interim manuals required.

3.2.3.3 Preliminary Manuals (Grade 3). The primary purpose of preliminary manuals is to establish the accuracy, adequacy, and usability of the contents of final manuals. As such, they will be used only by TDS Computer Program Manager or representative personnel. However, a secondary purpose of preliminary manuals is to provide a basis for the production of interim manuals when the latter are required. Therefore, text pages of preliminary manuals shall be final typed and prepared so that they may be utilized to reproduce copies for interim manuals in the most expeditious manner. Similar attention should be given to line illustrations. The intent is to allow preliminary manuals to be produced by the most economical means commensurate with the requirements for completeness of contents and methods of organization and presentation. The production requirements for preliminary manuals shall be the same as presented for final manuals in paragraph 3.2.3.1, except as modified following:

(1) All copy shall be typewritten full page width (one column 42 picas wide); double-spaced within paragraphs, notes, lists, etc.; and triple-spaced between such items. The copy shall be such that clear, readable reproductions may be obtained. Any method of duplication that will provide the necessary quantity of black, legible copies will be acceptable.

(2) Only right-hand pages shall be prepared; left-hand backups shall be blank. Right-hand pages shall be numbered consecutively in the same manner as the left- and right-hand pages of final manuals.

(3) All illustrations shall be on separate pages from the text; more than one illustration may be on an illustration page when illustrations are small and legibility can be maintained. Illustrations shall be prepared by the most economical method that will still result in clear, legible reproductions.

(4) Illustration pages (except foldouts) shall be interspersed with text pages so that illustrations are located following and as close to text references as is possible.

(5) Foldout pages containing diagrams shall be bound into separate covers. Each volume shall contain the necessary identification and security classification information on its cover and shall reference its relationship to the parent text volume. Also, it shall contain a list-of-illustrations page in figure number order that contains the figure titles and page numbers. Foldout pages shall be approximately the same size, determined by the minimum size of the largest diagram that will still result in legibility. Aprons or preceding apron-sized pages shall be used for each foldout diagram as required to list related notes, legends, etc.

(6) Front matter of the text volume may consist of only the title page, table of contents, and list of illustrations and tables.

(7) Preliminary manuals are not subject to 35-mm microfilming.

(8) Page running heads and feet may consist of only (1) security classification, (2) short title of document, (3) name of issue ("original"), and (4) page number.

(9) Tabbed divider pages are not required.

(10) Any good-quality paper stock suitable for the intended method of reproduction shall be satisfactory for text and foldout pages. Cover stock shall be sturdy enough to take reasonable abuse;

the color of cover stock shall conform to the security-classification requirements for final manuals.

(11) Volume front covers need not include any printed matter other than the security classification if cut-out windows are used and the long title and volume identification contained on the following title or subtitle page can thus be seen.

(12) The number of copies of preliminary manuals that shall be produced by the contractor will be determined by the TDS Computer Program Manager for each individual case, to depend on the size and complexity of the task of preliminary manual evaluation.

3.2.3.3.1 Outline Approval. An outline of the preliminary manual, showing the intended format and content headings and subheadings, shall be submitted at the first in-process review.

3.2.4 Changes. Changes to manuals may be initiated and regulated as an integral part of a configuration-control program for the related system or project. Changes also may be made independent of such a program. Regardless of the manner of initiation and regulation, manual changes may be produced as (a) temporary changes, (b) permanent changes, or (c) revisions. Changes shall be required when a manual will not accurately or adequately cover its system or subject because of production or field change being made to hardware or software. Manual changes must be delivered coincident with delivery of the new system configuration or program change covered by the manual changes. The overall plan of accomplishment shall integrate the preparation and production of manual change with the preparation and production of hardware or software change.

3.2.4.1 Configuration Changes Hardware. Occasions may arise when configuration changes do not apply to the entire system, such as when hardware or software are used in two or more different systems, or are used independently as well as with one or more systems, etc. Similarly, an original system installed in two or more different sites may be modified eventually for only one or

several of the installations, or may be modified differently at the different installations. Changes to original manuals must conform to these variations. Instructions that accompany such manual changes, as well as the revised data in the manual, must account for all variations and identify the affected systems, hardware, or installations when a blanket distribution is made to the entire system and it is not feasible to include control of manual distribution within the overall configuration control program.

3.2.4.2 Configuration-Control Manual Changes. The concepts of integrated logistics support and continual military readiness may be implemented in part for the system or computer program by a configuration-control program which includes control of changes to the related manuals. For such a program, a manual change is considered as essential as a circuit change without which the newly configured system cannot function. Techniques must be established and maintained by the contractor (such as assigning writers at the very beginning of a change program, and allotting adequate priorities and man-hours to accomplish the task) which allow for delivery of manual changes simultaneously with delivery of the related hardware or software changes. In this regard, the TDS Computer Program Manager or his representative may be consulted to establish milestones, etc., which will help to ensure successful performance. The requirements of paragraphs 3.2.4.4 through 3.2.4.8 shall apply to configuration-control manual changes wherever they do not conflict with official configuration-control requirements.

3.2.4.3 Manual Changes Not Under Configuration Control. Changes required to correct manual errors or oversights may be made independent of the configuration-control program for the system or program. The requirements of paragraphs 3.2.4.4 through 3.2.4.8 shall apply to these types of manual changes.

3.2.4.4 Temporary Changes. Temporary changes shall be approved by TDS Computer Program Manager and shall be supplied when there is insufficient time to publish corrected or added information in a manual prior to final delivery of the manual, when making minor changes to be superseded shortly by permanent changes, or when

changing preliminary manuals. A temporary change shall consist of detailed instructions for making the change plus additional pages as necessary. Temporary changes shall be produced by the most economical means that ensure legibility.

3.2.4.4.1 Instructions. Instructions shall be prepared on a combination covering-letter/instruction-sheet, as follows:

(1) The short title and the temporary-change number (T-1, T-2, etc.) shall appear in the upper left-hand corner of each page.

(2) The total number of pages shall be indicated on the first page.

(3) The security notice shall appear on the first page of all classified temporary changes. The security classification of the temporary change shall appear on the top and bottom of each page of classified temporary changes. The word UNCLASSIFIED shall appear at the top and bottom of each page of unclassified temporary changes.

(4) A statement shall be made indicating when the temporary change is in effect. If it supersedes an earlier temporary change or permanent change, a statement to that effect shall be given.

(5) A statement shall be made indicating the purpose of the change and the extent to which it applies to the system. When applicable, all change numbers shall be referenced in the instructions.

(6) Instructions shall be given for making specific pen-and-ink changes. The instructions shall be terse yet clear. Specific data to be changed shall be set off in quotation marks. Pen-and-ink changes shall not be allowed when the time required to make them is more than one minute per page or where the space available does not permit insertion without affecting the clarity of the text. In such instances, changes shall be printed on additional pages, and instructions shall be given on the instruction sheet to make a pen-and-ink note on the affected handbook page referencing the temporary additional page. Illustrations and diagrams shall be used where needed and be printed on additional pages.

(7) A list of any revised (replacement) manual pages that are issued as a part of the temporary change shall be included. Instructions shall be given for inserting the new or revised pages, for disposition of old pages, and for correcting the title page and list of effective pages.

(8) The instructions shall contain a statement that the temporary change instruction sheet, along with the additional pages that are not inserted elsewhere in the manual, shall be inserted immediately behind the front cover and shall precede any previous changes.

(9) Gutter width of the temporary change pages shall be wide enough so that none of the copy will be obscured when the pages are inserted into the affected publication.

(10) All temporary-change pages shall be stapled together through the upper left-hand corner. If two or more temporary changes are in effect, they shall be assembled with the highest temporary change number on top.

(11) All pages shall be drilled or punched with hole spacing to fit the binding of the original handbook.

3.2.4.5 Permanent Changes. In Addition to incorporating the latest or current change information, permanent changes shall be prepared to include and supersede all temporary changes issued since the manual was published or since the last permanent change, and shall enumerate the temporary corrections so superseded. If more than 40 percent of the total pages of the manual (or volume) is affected, the manual (or volume) shall be reissued as a completely revised manual. This includes back-up pages to the current change, plus pages affected by previous changes as listed in the existing "List of Effective Pages." However, if the manual or volume consists of 20 pages or less, it shall be revised rather than changed, if such revision is approved by the TDS Computer Program Manager.

3.2.4.5.1 Instructions. A permanent change shall be produced to the same requirements specified for the original manual. Pen-and-ink changes shall be limited to minor items which can be conveniently and readily transcribed. The permanent change shall include an instruction sheet prepared to the same requirements as the one for a temporary change except for substitution of "CHANGE (number)" for "T-(number)." Change numbers shall be requested from the TDS Computer Program Manager. A permanent change shall also include the following:

(1) A revised title page, including the original approval date and the approval date of the change. The original short title shall be used. When approved by the TDS Computer Program Manager the title page may be revised by a pen-and-ink correction.

(2) A revised list of effective pages. When approved by TDS Computer Program Manager, permanent changes involving only a few pages may include instructions for making pen-and-ink corrections to the list of effective pages.

(3) Instructions for inserting the new pages.

(4) Instructions for disposing of superseded pages and temporary changes.

(5) A list of pages that have pen-and-ink changes. This list shall appear on the same page as, and in format similar to, the list of effective pages.

(6) Revised pages of the table of contents, list of illustrations, and list of tables, when applicable.

(7) Inclusion of the number of the change at the bottom of each new page, across from the page number. For example, if the new page is part of the second change, "CHANGE 2" is printed in place of "ORIGINAL" or "CHANGE 1," depending on what was the latest previous issue of that page.

(8) Unrevised sides of revised pages shall be reprinted as backup sides to the new sides, and shall contain the change number of their own latest issue, and not the number of the change of the revised side of the page.

(9) Additions and deletions of paragraphs, sentences, figures, tables, parts listing, etc. shall be indicated on the affected pages. This indication shall be by means of 1/16-inch vertical black bars placed at the outside edge of the text column or the figure or table so affected. The bar shall run the full length of the change being indicated.

3.2.4.6 Continuity of Numbering Systems. New inserted paragraphs shall be numbered with the number of the preceding old paragraph, followed by a suffix capital letter beginning with "A." For example: paragraphs added after paragraph 1.6 shall be marked in the manual as 1.6A, 1.6B, etc. For added illustrations or tables, figure or table numbers shall be assigned in a manner similar to the assignment of added page numbers. Revised pages shall replace pages of the same number, if possible. Inserted pages shall be numbered with the preceding left-hand page number followed by a suffix capital letter, beginning with "A;" for example: 1-22A, 1-22B. If additional copy is added to a right-hand page, the overrun from this page shall be carried over to the following left-hand page, and the overrun from the left-hand page shall be carried on the added page. When deletions eliminate a numbered item, a phrase indicating the deletion shall replace the item; i.e., "Paragraph 3.16 deleted." When entire pages are deleted, a new page containing the statement of the fact shall replace them; i.e., "Pages 3-11 through 3-16 deleted." Running heads and running feet shall be the same as for basic manuals, but shall include suffix capital letters, as required.

3.2.4.7 Supplements to Manuals. To cover an extensive change to a manual, such as the addition or substitution of major units, the TDS Computer Program Manager will consider the use of a supplement to the original publication in lieu of revised permanent-change pages for the publication. The titles of supplements shall indicate the relationship to the initial publication. Preparation and production requirements of supplements shall be the same as the requirements imposed on original manual.

5.2.4.8 Revised Manuals. A revised manual is a republication of the entire manual. In multivolume manuals this may include all volumes or only one or several volumes. A revised manual is so designated by its revised short title (official number) and not by a change number. All pages of a revised manual shall be "ORIGINAL" pages. The criterion for requiring a revised volume is the number of pages affected by a change. When the number of pages affected exceeds 40 percent of the total pages, the entire volume shall be reprinted and republished. This includes those pages affected by previous changes as well as those affected by the current change. A revised manual or volume shall be prepared and produced in accordance with the requirements specified herein.

4. QUALITY ASSURANCE

4.1 General. Unless otherwise specified in the contract or purchase order, the contractor is responsible for compliance with all inspection requirements as specified herein. The Navy reserves the right to perform such inspection as it deems necessary to assure that documentation conforms to prescribed requirements, including inspections at various stages of development. Final manuals shall be inspected to determine equivalence with the approved preliminary manuals and with the approval letter.

4.2 Quality Program Requirements. The contractor shall provide and maintain a written quality program acceptable to the Navy. The quality program shall be in accordance with the following requirements of MIL-Q-9858A:

- (1) Quality program management.
 - (a) Organization.
 - (b) Initial quality planning.
- (2) Facilities and standards.
 - (a) Drawings documentation and changes.
- (3) Control of purchases.
 - (a) Responsibility.
 - (b) Purchasing data.
- (4) Manufacturing control.
 - (a) Completed item inspection and test.
- (5) Coordinated Government/Contractor actions.
 - (a) Government inspection at subcontractor or vendor facilities.

4.2.1 In addition to the requirements specified in 4.2, the quality program shall be delineated in sufficient depth to assure that adequate and accurate data and procedures are presented in

manuals, and that materials being prepared and furnished in support of manuals are in accordance with the requirements of this specification. The quality program, as a minimum, takes into account areas of concern such as the following:

(1) Definition of authority, function, and duties of those responsible for preparation and inspection of the manuals.

(2) Designation of qualified personnel for the preparation and inspection of the manuals.

(3) Development, issuance, maintenance, and distribution of procedures for preparation and inspection of the manuals.

(4) Coordination with design and production activities to assure that the latest technical data, operating and maintenance procedures, and drawings are used in the preparation of the manuals and that revisions to the manuals are made concurrent with revisions to the equipment design.

(5) Establishment of validation procedures, inspection points, and inspection criteria, and conducting these designated inspections to determine the adequacy and accuracy of the manuals during the development stages.

(6) Formal detailed review to assure the adequacy of the instructions in the manuals for installation, operation, and maintenance of the system or program, as applicable, and compliance with this specification and the purchase specification for both content and production.

(7) Actual examination of the content of the manual against the program being furnished to assure that it depicts accurately and adequately the program and that test, operation, and maintenance procedures can be performed by personnel of the level for which the manual is written using equipment normally available aboard the vehicle which will contain the system or equipment.

4.2.2 Acceptance of the quality program by the Government is not intended to preclude additions, refinements, or changes to the written quality program, where evidence indicates the need for such action, by the Navy.

4.3 Approval Control Authority. The TDS Computer Program Manager is responsible for all reviews and inspections of technical manuals for electronics systems and programs. The TDS Computer Program Manager may designate an approval group to function as its representative in conducting such reviews and inspections. The purpose of the reviews and inspections is to preclude and eliminate technical and editorial errors and oversights and to ensure the completeness, adequacy, and usability of documentation.

4.4 Approval Procedures. Stages and requirements of inspection for Type II manuals are presented in paragraphs 4.4.1 through 4.4.4. These inspections should not be construed as taking the place of an engineering review or validation by the contractor. The contractor shall still be responsible for his own engineering review and validation of the manuals he prepares, and for coordinating accomplishment of such through the TDS Computer Program Manager. Both for his own validation and for the preliminary-manual review by the TDS Computer Program Manager (4.4.2), the contractor shall have the subject system or program on hand, and shall ensure that the system or program is in good working condition. Prior consultation between contractor and the TDS Computer Program Manager is recommended to establish target dates and to reach complete agreement on the intents and purposes of the performance and inspection programs.

4.4.1 In-process Reviews. After outline approval and before completion of the preliminary manual, inspections shall be made by the TDS Computer Program Manager or assigned approval group at the contractor's plant to assure compliance with this specification, ascertain progress, answer questions, offer suggestions, waive old requirements and establish new requirements, etc. Other than helping to assure quality of the final manual, the purpose of these inspections is to forestall unsatisfactory preparations which would increase contractor cost and effort and delay delivery.

4.4.2 Preliminary Manuals. (Grade 3) Preliminary manuals shall be comprehensively inspected and reviewed by the TDS Computer Program

Manager or assigned approval group. Preliminary manuals shall have utilized the data of Type I documents, shall have followed the approved manual outlines, and their contents shall be complete and be suitable for use in producing the final manual. Approval will be based on compliance with the foregoing as well as (though not limited to) the following:

- (1) Absence of technical and editorial errors, as checked by the approval group against the subject system or equipment which is to be at hand.
- (2) Usability by Navy personnel for whom intended.
- (3) Correct emphasis (detailed coverage of complex items, brief coverage of simple items).
- (4) Absence of redundant and unnecessary coverage.
- (5) Proper text style and format.
- (6) Adequate support of text by illustrations, and vice versa.
- (7) Consistency of callouts and nomenclature throughout text and illustrations. A check shall be made of key items; for example, names of controls in the functional description shall be checked against names used in operating and maintenance procedures. Partial and overall schematic diagrams shall be checked against each other for consistency.
- (8) Absence of extraneous illustrations.
- (9) Compliance with production requirements.

4.4.2.1 Letter of Approval. A letter to the contractor will be prepared after approval of the preliminary manual, stating the conditions of approval.

4.4.3 Interim Manuals. (Grade 2) When an interim manual is required, it shall be inspected and reviewed by the TDS Computer Program Manager or assigned approval group against the approved preliminary manual from which it was prepared. Approval will be based

on its agreement with the parent preliminary manual including the changes, if any, that resulted from the preliminary-manual inspection. In addition, interim manuals shall comply with the production requirements.

4.4.4 Final Manuals. (Grade 1) The final manual shall be inspected and reviewed by the TDS Computer Program Manager or assigned approval group against the approved preliminary manual from which it was prepared. Approval will be based on its agreement with the parent preliminary manual including the changes, if any, that resulted from the preliminary-manual inspection. In addition, the final manual shall comply with the production requirements.

4.5 Changes. Changes (including supplements and revisions) to original manuals are subject to approval of the TDS Computer Program Manager or approval group before being produced for distribution. Plans for the preparation of changes should be coordinated between contractor and TDS Computer Program Manager to facilitate contractor preparation and final acceptance by the TDS Computer Program Manager or approval group. Approval of changes is based on their compliance with the applicable requirements and on the accuracy, completeness, and usability of their contents.

5. DELIVERY

5.1 General. The contractor shall request instructions from the TDS Computer Program Manager regarding delivery of manuals and submittals for record. These instructions should be requested 30 days prior to anticipated shipping dates.

5.2 Preparation. All classified material shall be packaged and marked in accordance with the requirements of DD 441 (Attachment).

5.2.1 Packaging and Packing of Manuals.

5.2.1.1 With Hardware. When copies of manuals are packed with hardware or software, they shall be packed within the shipping container. All manuals shall be so placed that they are readily accessible prior to removing the hardware or software, and shall not be placed within the vapor-proof barrier material used to enclose the hardware or software. Manuals accompanying hardware shall be separately packaged in a waterproof container. The invoice, packing list, or bill of lading shall include the publication number (short title) of the manual and the quantity; they shall also indicate which container includes the manual.

5.2.1.2 Without Hardware. Individual copies and multivolume manuals shall be packed to preclude the possibility of damage in transit. Multivolume manuals shall be furnished as complete sets except when bulk-shipped for stock.

5.2.1.3 Bulk Shipment. Manuals shipped in bulk shall not be individually wrapped. For multivolume manuals, stock copies of identical volumes shall be packed and bulk-shipped in common containers. Containers shall comply with the Uniform Freight Classification Rules or other carrier regulations as applicable to the mode of transportation. Interior packages and exterior shipping containers shall be marked with the following information for each item enclosed:

(1) Box (number) of (number of boxes, on multiple container shipments).

- (2) Publication number.
- (3) Quantity within the package.
- (4) Contract or order number.

The words "FOR STOCK" shall be marked on the package or packages destined for stock. The publication numbers shall be indicated on the shipping papers. When a contract or order requires manuals having different publication numbers, the stock copies of each manual shall be shipped separately. All bulk shipments shall be in accordance with security requirements.

5.2.1.4 Interim Manuals. Interim manuals shall be prepared for shipment in the same manner as for final manuals. In addition, except for interim manuals for developmental or experimental hardware, a self-addressed (to the contractor) postal card containing information similar to the following notice shall be enclosed with each interim manual attached to the title page:

"IMPORTANT NOTICE: This is an interim manual for (insert nomenclature of system or program), publication (insert number). The final manual will be forwarded when ready. Return this card immediately indicating ship or shore activity and mailing address."

5.2.1.5 Changes, Revisions, and Supplements. Changes, revisions, and supplements shall be prepared for shipment in the same manner as for bulk shipment of final manuals.

5.2.1.6 Manuscript Copy. Manuscripts shall be packaged according to the applicable requirements specified for the bulk shipment of final manuals.

5.2.1.7 Artwork and Reproducible Copy. Text pages and artwork shall be arranged in groups according to size and shall be packaged so that all reproducible copy and artwork will lay flat and withstand rough handling.

5.2.1.8 Submittal for Record. When contracted for, negatives shall be furnished as individual page negatives and shall be collated in numerical sequence by page number (except for foldouts). The page and publication numbers shall be prominently marked on each negative in a consistent location. A slip sheet of manifold, tissue, or other suitable paper shall be inserted between negatives. Foldout negatives also shall be arranged in numerical sequence but packaged separately from the page-size negatives. Negatives shall be packed flat; rolled negatives are not acceptable. Glossy prints shall be packaged so that the material will lie flat and withstand rough handling.

5.3 Quantity and Distribution.

5.3.1. Final Manuals. The quantity of final manuals shall be as specified in the contract, order, or specification. Unless otherwise specified, the contractor shall be responsible for the distribution of all manuals procured on the contract or order.

5.3.2 Interim Manuals. The quantity and distribution of interim manuals shall be as specified in the contract. If interim manuals must be provided with the first delivery of production software, the quantity in the case of manuals shall be two per software item up to the bulk required for final documentation. Distribution will be as directed. Distribution of bulk shall not be later than two weeks prior to the shipment of the first item of software.

5.3.3 Changes, Revisions, and Supplements. The quantity of changed, revised, or supplemental manuals shall be as specified in the contract, order, or specification. The distribution of such material shall be to all activities receiving the original documentation and in the same quantity for each, or as directed by the TDS Computer Program Manager.

6. NOTES

6.1 Information for Contractors. All questions concerning this specification should be referred to the TDS Computer Program Manager.

6.2 Ordering Data. Procurement documents shall specify the following:

- (1) Title and number of this specification.
- (2) Security classification.
- (3) Quantity of manuals required.
- (4) Type and grade of documentation being procured
- (5) Conditions that will require production and delivery of interim manuals.
- (6) Address of TDS Computer Program Manager and/or assigned approval group.

6.3 Reproduction Rights. Reproduction rights shall be as established by the provisions of the contract pertaining to data or copyright. If material is copyrighted, the manual shall include a statement adjacent to the copyright notice as to the rights of the Government thereunder.

6.4 Liability Notice. When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

6.5 Publication Numbers. The publication number for each manual will be provided by the TDS Computer Program Manager, upon receipt of a request from the contractor.

APPENDIX 1
FORMAT AND CONTENT REQUIREMENTS
FOR A TACTICAL DATA SYSTEM
COMMAND AND STAFF MANUAL

APPENDIX 1
TABLE OF CONTENTS

	<u>Page</u>
SECTION 1 - PREFACE	1
1.1 Purpose of Manual	1
1.2 Scope of Manual	1
1.3 Applicability of Manual	1
1.4 Reference Documents	1
SECTION 2 - SYSTEM DESCRIPTION	3
A. Purpose of Section	3
B. Content Requirements	3
C. Organization of Contents	4
SECTION 3 - TARGET DETECTION	5
A. Purpose of Section	5
B. Content Requirements	5
C. Organization of Contents	5
SECTION 4 - DATA PROCESSING AND DISPLAY	6
A. Purpose of Section	6
B. Content Requirements	6
C. Organization of Contents	6
SECTION 5 - TARGET TRACKING	7
A. Purpose of Section	7
B. Content Requirements	7
C. Organization of Contents	7
SECTION 6 - MISSION CONTROL	8
A. Purpose of the Section	8
B. Content Requirements	8
C. Organization of Contents	9
SECTION 7 - COMMUNICATIONS	10
A. Purpose of Section	10
B. Content Requirements	10
C. Organization of Contents	11
SECTION 8 - NAVIGATION	12
A. Purpose of Section	12
B. Content Requirements	12
C. Organization of Contents	12

APPENDIX 1
TABLE OF CONTENTS (Continued)

	<u>Page</u>
SECTION 9 - SYSTEM MAINTENANCE	13
A. Purpose of the Section	13
B. Content Requirements	13
C. Organization of Contents	13
SECTION 10 - GLOSSARY OF TERMS	14
A. Purpose of Section	14
B. Content Requirements	14
C. Organization of Contents	14

SECTION 1 - PREFACE

This section shall serve as an introduction to the manual, and shall be organized into subsections as indicated below.

1.1 Purpose of Manual. This subsection shall inform the reader of what the manual is about and for whom it is intended.

Sample Statement of Purpose. "The Command and Staff Manual provides flag and senior officers with a basic description of system functions, operational capabilities, and limitations of the Tactical Data System."

1.2 Scope of Manual. This subsection shall provide a brief description of the contents of the manual.

Sample Statement of Scope. "This manual gives a synoptic treatment of the characteristics, operational employment capabilities, and limitations of the total system and of the subsystems that constitute the Tactical Data System."

1.3 Applicability of Manual. This subsection shall denote the system complex, model(s), and configuration(s) to which the manual applies.

Sample Statement of Applicability. "The information in this manual applies to _____ class/model of ship/aircraft number _____ and subsequent, configured with the _____ Tactical Data System, functioning with the _____ model program(s)."

1.4 Reference Documents

1.4.1 Referenced. This subsection shall list those documents referenced or quoted, or from which illustrations, tables, or listings were extracted, in whole or in part.

1.4.2 Applicable. This subsection shall list those documents not referenced in the manual but applicable to the system or program for which the documentation has been produced. For example, the companion volumes and manuals of system documentation, while perhaps not referenced, would be applicable.

Appendix 1

1.4.3 The listings of reference and applicable documents (per 1.4.1 and 1.4.2) shall be in the following order:

- (1) Specifications
 - a. Military
 - b. Federal
- (2) Standards
 - a. Military
 - b. Federal
 - c. Commercial
- (3) Military Publications and Documents
 - a. Manuals
 - b. Handbooks
 - c. Miscellaneous
- (4) Commercial Publications and Documents
 - a. Manuals
 - b. Handbooks
 - c. Miscellaneous

NOTE

In the event that no publications, documents, specifications, or standards are referenced or applicable, the word "None" shall appear in the appropriate section.

SECTION 2 - SYSTEM DESCRIPTION

A. Purpose of Section. This section shall contain brief descriptions of the total system characteristics, capabilities, and tactical applications.

B. Content Requirements. A subsection shall be devoted to each of the following:

(1) Mission and Applications. This subsection shall serve to introduce the reader to the tactical purpose served by the system.

(2) System Functions. This subsection shall contain a paragraph or two of synoptic description of each of the system's major functions, denoting which of the functions are automatic, manual, or capable of being operated in either mode.

(3) System Capabilities and Limitations. This subsection shall define the designed capabilities of the system and its operational limitations as imposed by equipment and environment.

(4) System Configuration

(a) This subsection shall contain a brief description of the major systems and their functional subsystems, such as detection and tracking, information processing and display, communications, and navigation subsystems. Each subsystem shall be dealt with in greater detail in subsequent sections devoted specifically thereto.

(b) Under each subsystem category there shall be a columnar listing of the associated equipment with a description of its individual function, as depicted below:

Equipment Nomenclature	Function
Computer Detector, CP-413/ASA-27	Accepts raw radar video, determines existence of valid targets, ... etc.

Appendix 1

(c) A functional block diagram shall be included, illustrating the integration of the entire system.

(5) System Manning Requirements and Description of Duties.
This subsection shall name the crew positions established as the minimum manning requirements, and shall contain a brief description of the duties of each crewman.

C. Organization of Contents. The contents of this section shall be organized in the following sequence:

- (1) System Mission and Applications.
- (2) System Functions.
- (3) System Capabilities and Limitations.
- (4) System Configuration.
- (5) System Manning Requirements and Description of Duties.

SECTION 3 - TARGET DETECTION

A. Purpose of Section. This section shall serve to:

(1) Briefly describe the problems associated with detection of the targets within the system's operating environment.

(2) Provide an explanation of the equipment functions involved in target detection.

(3) Define the system's detection capabilities and limitations.

B. Content Requirements

(1) A subsection shall be devoted to each major phase of the detection process.

(2) Functional descriptions shall be brief, void of detail extraneous to the purpose of this manual; and, insofar as is feasible, in terms which can be understood in context by the operationally oriented reader.

C. Organization of Contents. The subsections shall be organized in a manner which establishes an orderly, progressive explanation of the detection process and the associated equipment.

SECTION 4 - DATA PROCESSING AND DISPLAY

A. Purpose of Section. The purpose of this section is to identify and briefly describe the functions performed by the data processing and display subsystems.

B. Content Requirements

(1) A subsection shall be devoted to each major function performed by the data processing and display subsystems and shall include brief descriptions of:

- (a) How the data is entered into the processing system.
- (b) How the data is processed.
- (c) How and where the data, both raw and processed, is displayed.

(2) Illustrations shall be provided which serve to:

- (a) Depict, identify, and define the data processing and display system controls and indicators; and
- (b) Depict and define the symbolic and alphanumeric displays utilized by the system.

(3) Functional descriptions shall be brief, void of detail extraneous to the purpose of this manual, and, insofar as is feasible, in terms which can be understood in context by the operationally oriented reader.

C. Organization of Contents. The subsections shall be organized in a manner which describes the sequence of data processing and display as it would take place within the system from an initial input of real-time data.

SECTION 5 - TARGET TRACKING

A. Purpose of Section. This section shall provide the reader with concise explanations of the methods and procedures used by the system to keep track of a target once it has been detected. It shall provide broad descriptions of how the system stores, retrieves, and uses data--from its sensing mechanisms and other sources--to identify targets, update the stored data, and provide specific information to the system operators on demand.

B. Content Requirements

(1) A subsection shall be devoted to coverage of each major phase of the target tracking function. Such coverage shall include, but is not limited to, discussion of the following functions and associated topics:

- (a) Automatic and manual identification of targets.
- (b) Correlation of target data.
- (c) Establishing tracks.
- (d) Position prediction.
- (e) Tracking modes.
- (f) Anomalies.
- (g) Limitations.

(2) Functional descriptions shall be brief, void of detail extraneous to the purpose of this manual; and, insofar as is feasible, in terms which can be understood in context by the operationally oriented reader.

C. Organization of Contents. While the organization of the topics listed in item 5B(1) shall follow closely the sequence listed therein, deviation from that sequence may be authorized to accommodate other functions and topics peculiar to the system being described. The intent is that the subsections be organized in a manner which establishes an orderly, progressive explanation of the tracking process as it is performed in an operational environment.

SECTION 6 - MISSION CONTROL

A. Purpose of the Section. The section shall provide the reader with concise explanations of the methods and procedures used by the system to accomplish the various missions for which it was designed and may be employed.

B. Content Requirements

(1) A subsection shall be devoted to each mission that the tactical data system is programmed to perform, and to those missions which can be performed by virtue of compatibility with the existing computer program.

(2) Where the mission is one of control, such as control of a weapon or weapon system, the content of the subsection shall provide the reader with explanations of the methods and procedures used by the Tactical Data System and its operators to establish and maintain control of the weapon system throughout the entire phase of the assignment.

(3) The contents of this section must be tailored to the functions of the subsystem. Where applicable, mission descriptions shall include, but are not limited to, the following:

- (a) Applicable tasks.
- (b) Mission control functions.
- (c) Modes of operation.
- (d) Operator functions and controls.
- (e) Inputs to the system
 - 1) Sensor data
 - 2) Communication data
 - 3) Manually entered data.
- (f) System Output
 - 1) Communication
 - 2) Displays
 - 3) Messages.

(g) Capabilities and limitations.

(h) Problem areas and considerations.

(4) Illustrations shall be included which represent the controls, displays, and geometry associated with the specific mission.

C. Organization of Contents

(1) Unless deviation can be justified, and is approved by cognizant government authority, the contents of each subsection devoted to the description of an operational mission shall be organized in general accord with the sequence listed in item 6B(3) herein.

(2) The addition or deletion of topics to those listed in item 6B(3) shall be managed so as to maintain a logical, progressive continuity.

SECTION 7 - COMMUNICATIONS

A. Purpose of Section. This section shall provide the reader with basic information concerning the system's communication capabilities, methods and procedures.

B. Content Requirements

(1) This section must be tailored to the specific design capabilities and tactical employment parameters of the system. While design characteristics and capabilities may remain constant, the procedures of communications may vary from one tactical situation or operational environment to another. Accordingly, where different environments and employment require differences in the methods or procedures of communication, an appropriately titled subsection shall be devoted to each.

(2) A subsection shall be devoted to brief coverage of the methodology, equipment functions, procedures, and problems concerned with the communications subsystem. Such coverage shall include, but is not limited to, the following:

(a) Methodology

- 1) Types of communications
- 2) Message types and contents
- 3) Modes of operation
- 4) Operator functions
- 5) Constraints.

(b) Equipment Operation

- 1) Controls
- 2) Inputs
- 3) Outputs
- 4) Displays
- 5) Limitations.

(c) Procedures

- 1) Normal
- 2) Degraded
- 3) Emergency.

(d) Functional block diagram of subsystem configuration.

(e) Illustration depicting communications link with other tactical units.

(f) Problem areas and considerations.

C. Organization of Contents. Insofar as is feasible, the organization of this section shall be in accordance with the sequence outlined in item 7B(2). Deviations which are considered justified must be approved by cognizant Government authority.

SECTION 8 - NAVIGATION

A. Purpose of Section. This section shall provide the reader with a concise, nontechnical explanation of the methods and procedures used to process navigational inputs to the system; and to navigate, position, or aid in the navigation of a weapon or weapon system it might be required to control or direct.

B. Content Requirements. This section shall include, but is not limited to, brief, functional descriptions of the following:

- (1) Subsystem functions
- (2) Modes of operation
- (3) Operator Functions and Controls
- (4) Peripheral Equipments
- (5) Inputs, Outputs, and Displays
- (6) Functional Block Diagram

C. Organization of Contents. This section shall be organized into subsections, the sequence of which shall be in accordance with item 8B.

SECTION 9 - SYSTEM MAINTENANCE

A. Purpose of the Section. This section shall provide the reader with concise explanations of the manner in which the system is maintained under operating and nonoperating conditions.

B. Content Requirements. This section shall contain descriptions of the concepts (but not of the technology) concerned with the following:

- (1) General maintenance concepts
- (2) Fault detection, isolation and malfunction analysis
 - (a) Equipment requirements
 - (b) Functional block diagrams
- (3) Repair Concepts
 - (a) Equipment requirements
 - (b) Space requirements
 - (c) Functional block diagram
- (4) Maintenance personnel requirements
 - (a) Positioning
 - (b) Training
- (5) Problem areas and considerations

C. Organization of Contents. This section shall be organized into subsections as listed in item 9B, unless justifiable deviations are approved by cognizant government authority.

Appendix 1

SECTION 10 - GLOSSARY OF TERMS

A. Purpose of Section. This section shall provide the reader with nontechnical definitions of certain terms and phrases as they are used in this manual.

B. Content Requirements. This section shall contain definitions of those terms and phrases which, because of their uniqueness, ambiguity, technicality, obscurity or peculiar application, should be defined to preclude misinterpretation and assist the reader in his understanding of the content.

C. Organization of Contents. The glossary shall be listed alphabetically (phrases by key word), and cross-referenced where applicable.

APPENDIX 2

FORMAT AND CONTENT REQUIREMENTS
FOR A TACTICAL DATA SYSTEM PLAN MANUAL

APPENDIX 2
TABLE OF CONTENTS

	<u>Page</u>
SECTION 1 - PREFACE	1
1.1 Purpose of Manual	1
1.2 Scope of Manual	1
1.3 Applicability of Manual	1
1.4 Reference Documents	1
SECTION 2 - SYSTEM DESCRIPTION	3
A. Purpose of Section	3
B. Content Requirements	3
C. Organization of Contents	4
SECTION 3 - TARGET DETECTION	5
A. Purpose of Section	5
B. Content Requirements	5
C. Organization of Contents	6
SECTION 4 - DATA PROCESSING AND DISPLAY	7
A. Purpose of the Section	7
B. Content Requirements	7
C. Organization of Contents	8
SECTION 5 - TARGET TRACKING	9
A. Purpose of the Section	9
B. Content Requirements	9
C. Organization of Contents	10
SECTION 6 - MISSION CONTROL	11
A. Purpose of the Section	11
B. Content Requirements	11
C. Organization of Contents	12
SECTION 7 - COMMUNICATIONS	13
A. Purpose of the Section	13
B. Content Requirements	13
C. Organization of Contents	14
SECTION 8 - NAVIGATION	15
A. Purpose of the Section	15
B. Content Requirements	15
C. Organization of Contents	17

TABLE OF CONTENTS (Continued)

	<u>Page</u>
SECTION 9 - SYSTEM MAINTENANCE	18
A. Purpose of the Section	18
B. Content Requirements	18
C. Organization of Contents	19
SECTION 10 - GLOSSARY OF TERMS	20
A. Purpose of the Section	20
B. Content Requirements	20
C. Organization of Contents	20

SECTION 1 - PREFACE

This section shall serve as an introduction to the manual, and shall be organized into subsections as indicated below.

1.1 Purpose of Manual. The intent of this subsection is to inform the reader of what the manual is about and for whom it is intended.

Sample Statement of Purpose. "The System Plan Manual provides functional information in depth regarding the functions, capabilities, characteristics, and applications of the _____ Tactical Data System. The manual is directed toward those who will be directly and personally involved in the operational planning for and tactical employment of the system."

1.2 Scope of Manual. It is the purpose of this subsection to provide a brief description of the contents of the manual.

Sample Statement of Scope. "This Manual gives detailed treatment to the characteristics, equipment functions, operational applications and capabilities of the subsystems that constitute the _____ Tactical Data System."

1.3 Applicability of Manual. The intent of this subsection is to provide information concerning the system complex, model(s) and configuration(s) to which the manual will apply.

Sample Statement of Applicability. "The information in this manual applies to _____ class/model of ship/aircraft number _____ and subsequent configured with the _____ Tactical Data System, functioning with the _____ model program(s)."

1.4 Reference Documents

1.4.1 Referenced. This subsection shall list those documents referenced or quoted, or from which illustrations, tables or listings were extracted, in whole or in part.

1.4.2 Applicable. This subsection shall list those documents not referenced in the manual but applicable to the system or program for which the documentation has been produced. For example, the companion volumes and manuals of system documentation, while perhaps not referenced, would be applicable.

Appendix 2

1.4.3 The listing of reference and applicable documents (per Sections 1.4.1 and 1.4.2) shall be in the following order:

- (1) Specifications
 - a. Military
 - b. Federal
- (2) Standards
 - a. Military
 - b. Federal
 - c. Commerical
- (3) Military Publications and Documents
 - a. Manuals
 - b. Handbooks
 - c. Miscellaneous
- (4) Commerical Publications and Documents
 - a. Manuals
 - b. Handbooks
 - c. Miscellaneous

NOTE

In the event that no publications, documents, specifications or standards are referenced or are applicable, the word "None" shall appear in the appropriate section.

SECTION 2 - SYSTEM DESCRIPTION

A. Purpose of Section. This section shall provide detailed descriptions of the total system characteristics, capabilities, and applications insofar as they would be of concern to those responsible for planning the missions and operationally using the system. While the descriptions in this manual are intended to be a level more detailed than those in the Command and Staff Manual, technicality of the nature required of a maintenance manual would be extraneous to the intent of this manual and shall be avoided.

B. Content Requirements. A subsection shall be devoted to each of the topics that follow.

(1) Tactical Missions and Applications. This subsection shall accomplish the following objectives:

(a) Describe the missions which the system was designed to perform;

(b) Define the mission parameters and describe in detail the applications in which the system's designed functions can be used;

(c) Provide a brief treatise on how the complete system functions as an integral unit to perform its missions;

(d) Describe how the system operates in concert with data systems and tactical units other than those it was designed to control.

(2) System Configuration. This subsection shall contain the items that follow:

(a) An illustrative breakdown of the system into major subsystems, with a brief explanation of each subsystem function;

(b) An illustrative breakdown of each of the subsystems, including a display of major components in each subsystem.

(c) A table, listing the nomenclature by major subsystem with brief functional descriptions of major associated equipment. (See following sample.)

Equipment Nomenclature	Function
Detection Subsystem CP/413 - ASA 27 computer detector	Processes raw radar input to determine target validity and height.

(3) Manning Requirements and Description of Duties. This subsection shall contain the items that follow:

(a) An illustration of the system showing realistic positions of each crewman or operator at the system controls, with each position identified.

(b) A brief description of each of the crewmen or operator's primary duties.

C. Organization of Contents. The contents shall be organized into subsectional headings as indicated in items 2B(1), 2B(2), and 2B(3) above.

SECTION 3 - TARGET DETECTION

A. Purpose of Section. This section shall provide the reader with a thorough description of the methods employed by the system to detect targets, and of the systems capabilities and limitations. Also, it shall provide the reader with an appreciation of the problems relating to detecting targets within the system's designed operating environments.

B. Content Requirements

(1) An introductory subsection shall contain a general description of the detection system function. It shall include a functional block diagram of the detection subsystem, and a description of the detection methodology.

(2) Subsections shall be devoted to a thorough description of each of the following major phases of the detection process.

(a) A functional description of the equipment concerned in each phase.

(b) A description of the operator functions.

(c) A description of the automatic functions.

(d) A delineation of the equipment capabilities and limitations.

(e) Illustrations of the equipment.

(f) Functional block diagrams of specific equipment, showing their integral relationship to the other elements of the subsystem.

(g) A table, listing the nomenclature of the detection subsystem and a description of the equipment function. (See following sample.)

Equipment Nomenclature	Function
AN/APS-96 Radar	Provides video inputs to the Computer Detector.....etc.

Appendix 2

(3) A subsection shall be devoted to a discussion of the physical problems associated with target detection in the system's operating environment. It shall define the problems and, when possible, provide recommendations as to the best method of resolving the problems in order to maximize the system's capabilities.

(4) Illustrations shall be provided that portray and identify the following items.

(a) The detection system hardware in its normal operating configuration and system environment,

(b) The operating controls and indicators.

C. Organization of Contents

(1) The subsections shall be organized in a manner which establishes an orderly, progressive explanation of the detection process.

(2) Where feasible, illustrations and diagrams shall be on the same page or adjacent to the applicable description.

SECTION 4 - DATA PROCESSING AND DISPLAY

A. Purpose of the Section. This section shall provide the reader with the information necessary to acquire a thorough understanding of the functions performed by the data processing and display subsystems. It shall also provide information concerning the effects of other major subsystem losses on the data processing and display capabilities.

B. Content Requirements

(1) An introductory subsection shall contain a general description of the data processing and display functions, and shall include the following items.

(a) A functional block diagram of the subsystem configuration that shows the relationship of the subsystem to other major subsystems in the total system.

(b) Illustrations which will portray, identify, and define the controls and indicators related to the data processing and display subsystem.

(2) A subsection shall be devoted to each major function performed by the data processing and display subsystems, and shall include thorough descriptions of the following procedures:

(a) The manner by which data enters the processing subsystem.

(b) The major steps required to process the data.

(c) The manner and location in which the raw and processed data are displayed.

(3) Illustrations shall be provided in each subsection that will portray, identify, and define the following items.

(a) The controls and indicators that relate to the functional description

(b) The symbolic and alphanumeric displays used that relate to the functional description.

(4) Functional descriptions shall be thorough and shall emphasize the information considered most vital to the operationally oriented reader.

C. Organization of Contents. The subsections shall be organized in a manner which describes the sequence of data processing as it would take place within the system from an initial input of real-time data.

SECTION 5 - TARGET TRACKING

A. Purpose of the Section. This section shall provide the reader with concise explanations of the methods and procedures used by the system to accumulate and correlate information on a target once it has been detected. It shall describe how the system stores, retrieves, correlates, and utilizes information from its sensing mechanisms and other sources to identify targets, update the stored data, and provide specific information to the system operators on demand. It shall also describe the effects of the loss of each major tracking subsystem component on the mission performance capability of the entire system.

B. Content Requirements

(1) An introductory subsection shall contain a general description of the tracking subsystem and shall include the items that follow.

(a) A functional block diagram of the tactical data system configuration, including sensor array, emphasizing the relationship of the tracking subsystem equipment to other major subsystems in the TDS complex.

(b) Illustrations that portray, identify, and define the controls and indicators related to the tracking subsystems.

(c) An illustration which depicts the entire tracking and correlation process to provide the reader with a clear, visual concept of each major step in the tracking scheme as it takes place, using the search cycle of the primary sensing device as the measure of elapsed time.

(d) A descriptive listing of all the functions performed by the tracking subsystem.

(e) A table, listing the nomenclature of the tracking subsystem and a description of the equipment function. (See following sample.)

Equipment Nomenclature	Function

(2) A subsection shall be devoted to detailed coverage of each major phase of the target tracking function. Coverage shall include, but is not limited to, descriptions of the following functions and associated topics.

- (a) Identification of targets.
- (b) Correlation of target data.
- (c) Establishing track identification and history.
- (d) Position prediction.
- (e) Tracking modes.
- (f) Anomalies.
- (g) Limitations
- (h) Associated problems and considerations.

(3) Functional descriptions shall be concise but thorough explanations. Mathematical treatment in the narrative text is extraneous to the purpose of this manual and shall be avoided, except that the geometry of the scheme may be illustrated. Mathematical equations and derivations used in the tracking scheme are incorporated in the Program Design Manual.

C. Organization of Contents. The organization of the topics listed in item 5B(2) shall follow the sequence listed therein. Deviations from that sequence may be authorized to accommodate other functions and topics peculiar to the system being described. The intent is that the subsections be organized in a manner which establishes an orderly, progressive explanation of the tracking process as it is performed in an operational environment.

SECTION 6 - MISSION CONTROL

A. Purpose of the Section. This section shall provide the reader with thorough explanations of the methods and procedures used by the system to accomplish the missions and tasks for which it was designed and may be employed.

B. Content Requirements

(1) An introductory subsection shall contain a listing of the missions and tasks within the system's capabilities, and shall include broad explanations of the means used by the system to effect mission control. Where more than a single mission capability is provided by the tactical data system, and if the means of program or operator control differ significantly, they shall be categorized in the introductory subsection in the order in which they will be expanded in subsequent subsections. The various tasks which may be assigned under a specific mission shall be explained within the framework of the mission subsection.

(2) A subsection shall be devoted to each mission that the tactical data system is programmed to perform. Additional subsections shall be devoted to describe missions that can be performed by virtue of compatibility with the basic computer program.

(3) Where the mission is one of control of a weapon or of a weapon system, the content of the subsection shall provide the reader with explanations of the methods and procedures used by the system, and by its operators, to establish and maintain weapon system control throughout the entire phase of the task assignment, such as target intercept or strike control.

(4) The content of this section must be tailored to the functions of the subsystem. Where applicable, mission descriptions shall include, but are not limited to, the items that follow.

Appendix 2

- (a) Applicable tasks.
- (b) Modes of operation.
- (c) Input to the system.
 - 1) Sensor data
 - 2) Communication data
 - 3) Manually entered data.
- (d) System output.
 - 1) Communication data
 - 2) Display
- (e) Limitations.
- (f) Problem areas and considerations.

(5) Illustrations shall be included which represent the controls, displays, and geometry associated with each mission and associated task or capability.

(6) Mathematical equations, derivations, and calculations shall not be used to illustrate the method by which mission geometry is conceived or computed. Such arithmetic matters are extraneous to the purpose of this manual and will be included in the Program Design Manual.

C. Organization of Contents

(1) The content of each subsection devoted to the description of an operational mission shall be organized in general accord with the sequence listed in item 6B(4). Deviation from that sequence may be authorized to accommodate other topics peculiar to the system being described.

(2) The addition or deletion of topics to those listed in item 6B(4) shall be managed so as to maintain a logical continuity.

SECTION 7 - COMMUNICATIONS

A. Purpose of the Section. This section shall provide the reader with complete information concerning the operating methods, procedures, and capabilities of the communications subsystem.

B. Content Requirements

(1) The content of this section must be tailored to the specific designed capabilities and tactical employment parameters of the system. While design characteristics and capabilities may remain constant, the procedures of communications may vary from one tactical situation or operational environment to another. Accordingly, where different environments and employment require differences in the methods or procedures of communication, an appropriately titled subsection shall be devoted to each.

(2) An introductory subsection shall contain a general description of the communications subsystem, and shall include the items that follow.

(a) A functional block diagram of the tactical data system configuration, in which the elements of the communication subsystem are emphasized in their relationship to other major subsystems in the complex.

(b) A functional block diagram of the communication subsystem in which the inter-relationship of the various components is illustrated and identified.

(c) Illustrations that will depict and identify the controls and indicators related to the communications subsystem.

(d) An illustration that will depict the communication link with other tactical units and data processing systems in an operation environment.

(3) Subsections shall be devoted to detailed coverage of the methodology, equipment functions, procedures, and problems concerned with the communications subsystem. Such coverage shall include, but is not limited to the items that follow.

(a) Methodology

- 1) Types of communications
- 2) Message types and contents
- 3) Modes of operation
- 4) Operator functions
- 5) Constraints

(b) Equipment Functions

- 1) Controls
- 2) Input requirements
- 3) Outputs
- 4) Displays
- 5) Limitations
- 6) A table, listing the nomenclature of the communications subsystem and a description of the equipment function. (See following sample.)

Equipment Nomenclature	Function
Radio Set, AN/ARC-80	A receiver-transmitter that carries.....etc.

(c) Communication Procedures

- 1) Normal
- 2) Degraded
- 3) Emergency

(d) Problems and Considerations. A subsection shall provide the reader with an awareness of the problems and phenomenon which may effect operational use of the system and, therefore, must be considered in planning and employment.

C. Organization of Contents. The organization of the illustrations and topics listed in items 7B(2) and 7B(3) shall follow the sequence listed therein unless deviation is authorized by cognizant Government authority. Additional topics may be authorized as appropriate.

SECTION 8 -- NAVIGATION

A. Purpose of the Section. This section shall provide the reader with a thorough explanation of the operating modes, procedures, and capabilities of the navigation subsystem as it may be used to navigate the system, or to position or aid in the navigation of a weapon or weapon system, when required.

B. Content Requirements

(1) An introductory subsection shall contain a general description of the theory of operation, and a listing of the functions that the navigation subsystem performs for the tactical data system. The subsection shall include, but is not limited to the items that follow.

(a) A functional block diagram of the total system configuration, in which the elements of the navigation subsystem are emphasized in their relationship to other major subsystems in the complex.

(b) A functional block diagramtic breakdown of the navigation subsystem in which the interrelationships of the various components and controls are illustrated and identified.

(c) Illustrations that portray and identify the controls and indicators related to the navigation subsystem.

(2) Subsections shall be devoted to detailed coverage of the methodology, equipment functions, procedures, and major problems which concern the navigation subsystem. Such coverage shall include, but is not limited to, the major topics that follow:

(a) Methodology. This subsection shall provide the reader with a knowledge of the scheme that is used by the navigation subsystem to provide the tactical data system with navigational information. The use of mathematical expressions to illustrate methodology shall be avoided; however, description shall include, but is not limited to the items that follow.

Appendix 2

- 1) Illustrations of pertinent geometry.
- 2) Illustrations of primary system components, such as the accelerometer and gyroscope.
- 3) Angle and distance measurement scheme (including accuracy expectations).
- 4) Coordinate conversion scheme.
- 5) Grid-lock scheme, if applicable.
- 6) Constraints

(b) Equipment Functions. This subsection shall contain descriptions which include, but are not limited to, the items that follow.

- 1) Modes of operation.
- 2) Controls
- 3) Input requirements.
- 4) Output.
- 5) Displays.
- 6) Limitations.
- 7) A table that lists the nomenclature of the navigation subsystem, and a description of the equipment functions. (See following sample.)

Equipment Nomenclature	Function
Data Display Bearing, distance, heading indicator, ID-663U	Displays drift angle of ownship, relative bearing of ownship to barrier center and relative bearing of ownship to destination

(c) Procedures. This subsection shall contain description of the procedures involved in the operation of the navigation subsystem and shall include, but is not limited to the items that follow.

- 1) Alignment.
- 2) Normal operation.
- 3) Emergency or degraded operation and capabilities.

AD-A054 037

ARINC RESEARCH CORP SANTA ANA CALIF WESTERN DIV
A SPECIFICATION FOR TACTICAL DATA SYSTEM COMPUTER PROGRAM DOCUM--ETC(U)
NOV 66 A M BARLOW, N J SCARLETT
414-04-5-693

F/G 9/2

N123(61756)56869A

NL

UNCLASSIFIED

2 OF 2

AD
A054 037



END
DATE
FILMED
6-78

DDC

(d) Problems and Considerations. This subsection shall provide the reader with an awareness of the problems and phenomenon that may effect operation or use of the system and, therefore, must be considered in planning and employment.

C. Organization of Contents. The organization of illustrations and topics listed in items 8B(1) and 8B(2) above, shall follow the sequence listed therein unless deviation is authorized by cognizant Government authority. Additional pertinent subtopics may be authorized under major subheadings.

SECTION 9 - SYSTEM MAINTENANCE

A. Purpose of the Section. This section shall provide the reader with descriptions of the methods used to maintain the system under operating and nonoperating conditions.

B. Content Requirements

(1) This section shall contain descriptions of the concepts and basic procedures (not of the technology) concerned with the items that follow.

(a) General maintenance concepts

- 1) Operating
- 2) Non-operating.

(b) Fault detection, isolation and malfunction analysis

- 1) Equipment requirement
- 2) Functional block diagrams
- 3) Table of equipment nomenclature and functional descriptions.

(c) Repair concepts

- 1) Equipment requirements
- 2) Space requirements
- 3) Functional block diagram
- 4) Table of equipment nomenclature and functional descriptions.

(d) Logistic support requirements

- 1) Deployed system
- 2) Not deployed.

(e) Maintenance personnel requirements

- 1) Training
- 2) Positions.

(f) Problem areas and considerations.

(2) An introductory subsection shall contain a general description of the system maintenance concepts and the theory behind them. The subsection shall include:

(a) A functional block diagram of the progressive flow of maintenance action required in deployed and nondeployed situations.

(b) Illustrations that will portray, identify, and define the maintenance equipment and the monitoring equipment, if any.

(3) Subsections shall be devoted to each of the major topics listed in item 9B(1). Functional descriptions shall be concise, but shall emphasize the information considered most vital to those responsible for planning and executing the employment of the system. It is not the intent of this section to serve in any way as a maintenance model.

C. Organization of Contents. The descriptive subsections shall be organized in accordance with the sequence established in item 9B. Justifiable deviations may be authorized by the cognizant Governmental authority. The intent is to provide the reader with an orderly concept of system maintenance methods, procedures, and requirements (manpower and logistics), progressing from the least complicated to the most complex situation.

SECTION 10 - GLOSSARY OF TERMS

- A. Purpose of the Section. The section shall provide definitions of terms and phrases as they are used in this manual.
- B. Content Requirements. The glossary shall contain definitions of those terms and phrases which, because of their uniqueness, ambiguity, technicality, obscurity, or peculiar application, should be defined to preclude misinterpretation.
- C. Organization of Contents. The glossary shall be listed alphabetically (phrases by key word), and cross-referenced where applicable.

APPENDIX 3 TABLE OF CONTENTS

APPENDIX 3 FORMAT AND CONTENT REQUIREMENTS FOR A TACTICAL DATA SYSTEM OPERATION MANUAL

1	SECTION 1 - INTRODUCTION
1.1	Purpose of Manual
1.2	Scope of Manual
1.3	Applicability of Manual
1.4	Reference Documents
2	SECTION 2 - SYSTEM DESCRIPTION AND APPLICATION
2.1	Purpose of Section
2.2	Content Requirements
2.3	Organization of Contents
3	SECTION 3 - COMPUTER OPERATING PROCEDURES
3.1	Purpose of Section
3.2	Content Requirements
3.3	Organization of Contents
4	SECTION 4 - DETECTION SUBSYSTEM OPERATING PROCEDURES
4.1	Purpose of the System
4.2	Content Requirements
4.3	Organization of Contents
5	SECTION 5 - TRACKING SUBSYSTEM OPERATING PROCEDURES
5.1	Purpose of the Section
5.2	Content Requirements
5.3	Organization of Contents
6	SECTION 6 - COMMUNICATION SUBSYSTEM OPERATING PROCEDURES
6.1	Purpose of the Section
6.2	Content Requirements
6.3	Organization of Contents
7	SECTION 7 - NAVIGATION SUBSYSTEM OPERATING PROCEDURES
7.1	Purpose of the Section
7.2	Content Requirements
7.3	Organization of Contents
8	SECTION 8 - MISSION CONTROL PROCEDURES
8.1	Purpose of the Section
8.2	Content Requirements
8.3	Organization of Contents

APPENDIX 3 TABLE OF CONTENTS

	<u>Page</u>
SECTION 1 — PREFACE	1
1.1 Purpose of Manual	1
1.2 Scope of Manual	1
1.3 Applicability of Manual	1
1.4 Reference Documents	1
SECTION 2 — SYSTEM DESCRIPTION AND APPLICATION	3
A. Purpose of Section	3
B. Content Requirements	3
C. Organization of Contents	4
SECTION 3 — COMPUTER OPERATING PROCEDURES	5
A. Purpose of Section	5
B. Content Requirements	5
C. Organization of Contents	6
SECTION 4 — DETECTION SUBSYSTEM OPERATING PROCEDURES	7
A. Purpose of the System	7
B. Content Requirements	7
C. Organization of Contents	8
SECTION 5 — TRACKING SUBSYSTEM OPERATING PROCEDURES	9
A. Purpose of the Section	9
B. Content Requirements	9
C. Organization of Contents	10
SECTION 6 — COMMUNICATION SUBSYSTEM OPERATING PROCEDURES.	11
A. Purpose of the Section	11
B. Content Requirements	11
C. Organization of Contents	12
SECTION 7 — NAVIGATION SUBSYSTEM OPERATING PROCEDURES	13
A. Purpose of the Section	13
B. Content Requirements	13
C. Organization of Contents	14
SECTION 8 — MISSION CONTROL PROCEDURES	15
A. Purpose of the Section	15
B. Content Requirements	15
C. Organization of Contents	15

SECTION 1 — PREFACE

This section shall serve as an introduction to the manual, and shall be organized as indicated below.

1.1 Purpose of Manual. This section shall inform the reader of what the manual is about and for whom it is intended.

Sample Statement of Purpose: "The System Operation Manual describes how the _____ Tactical Data System is to be operated. The manual is for use as a training text and as an operating manual for personnel concerned with operating the system in the tactical and maintenance environments."

1.2 Scope of Manual. This section shall provide a brief description of the contents of the manual.

Sample Statement of Scope: "This manual provides, for each crewman/operator position, detailed information relative to equipment-operation and operator functions required in the mission performance of the Tactical Data System."

1.3 Applicability of Manual. This section shall denote the system complex, model(s), and configuration(s) to which the manual applies.

Sample Statement of Applicability. "The information in this manual applies to _____ class/model of ship/aircraft number _____ and subsequent, configured with the _____ Tactical Data System, functioning with the _____ model program(s)."

1.4 Reference Documents

1.4.1 Referenced. This section shall list those documents referenced, quoted, or from which illustrations, tables or listings were extracted, in whole or in part.

1.4.2 Applicable. This section shall list those documents not referenced in the manual but applicable to the system or program for which the documentation has been produced. For example, the companion volumes and manuals of system documentation, while perhaps not referenced, would be applicable.

1.4.3 The listing of reference and applicable documents (per Sections 1.4.1 and 1.4.2) shall be in the following order:

- (1) Specifications
 - a. Military
 - b. Federal
- (2) Standards
 - a. Military
 - b. Federal
 - c. Commerical
- (3) Military Publications and Documents
 - a. Manuals
 - b. Handbooks
 - c. Miscellaneous
- (4) Commerical Publications and Documents
 - a. Manuals
 - b. Handbooks
 - c. Miscellaneous

NOTE

In the event that no publications, documents, specifications, or standards are referenced or applicable, the word "None" shall appear in the appropriate section.

SECTION 2 — SYSTEM DESCRIPTION AND APPLICATION

A. Purpose of the Section. This section will provide the operator with basic information concerning the system's designed operational purpose, capabilities, and configuration; coverage shall also be given to manning and support requirements.

B. Content Requirements. A subsection shall be devoted to each of the following topics:

(1) Tactical Missions and Applications. A subsection shall be devoted to each mission, the content of which subsection shall serve to accomplish the following:

(a) Acquaint the reader with the mission(s) that the system was designed to perform.

(b) Define the mission parameters and describe in detail the operational applications that can be made of the system's designed functions.

(c) Provide a brief account of how the complete system functions as an integral unit to perform its mission(s).

(d) Describe how the system operates in concert with other data systems and tactical units.

(2) System Configuration. This subsection shall contain the following:

(a) An illustrative breakdown of the total system into the major subsystems.

(b) Detailed explanations of each of the major subsystem functions.

(c) An illustrative breakdown of each of the subsystems, displaying its major components.

(d) A table, listing by major subsystem, the nomenclature and brief functional description of major associated equipment.
(See sample table.)

Equipment Nomenclature	Function
DETECTION SUBSYSTEM: CP/413-ASA 27 Computer Detector	Processes raw radar input to determine target validity and height

(e) Accurately scaled and carefully detailed illustrations which depict and identify the console, controls and indicators associated with each crewman/operator position.

(d) A table, indexed to the console illustrations required in B(2)(e) above, which defines the functions of the controls.

(3) Manning Requirements and Description of Duties. This subsection shall contain the following:

(a) An illustration of the system, depicting, as realistically as practicable, the position of each crewman/operator at the controls of the tactical data system, with appropriate identification of position.

(b) A complete description of the duties of each crewman/operator.

(c) For each crewman/operator position, a table listing the basic functions normally performed by that individual, and the equipment normally operated by him in the performance of his duties.

(d) Alternate duties which can be performed by each operator without leaving his position.

C. Organization of Contents.

(1) The organization of topics, illustrations and tables, shall follow the sequence outlined in B herein, unless otherwise authorized by cognizant Government authority.

(2) Instructions for each crewman/operator shall be contained under separate, appropriately titled subheadings.

SECTION 3 — COMPUTER OPERATING PROCEDURES

A. Purpose of the Section. This section shall provide all instructions and procedures necessary for operation of the digital computer.

B. Content Requirements. A subsection shall be devoted to each of the following topics:

(1) Computer Configuration. This subsection shall acquaint the reader with the elements comprising the data processing device, and shall include the following:

(a) A block diagram of the computer, displaying its interface with other components of the tactical data system.

(b) A table, listing in one column each major component and removable assembly of the computer by its standard nomenclature and common name and, in a second column, the functional purpose of the component.

(c) An illustration which depicts and identifies the computer controls and indicators.

(d) A table, keyed to the illustration required above, which lists in one column the nomenclature of the control, and in another column describes the function of the control.

(2) Program Loading Procedures. This subsection shall provide step-by-step instructions for the loading of a program into the computer memory. Included shall be appropriate illustration(s) that will enhance an understanding of the procedures.

(3) Test and Checkout Procedures. This subsection shall contain complete, step-by-step instructions for the pre-operative computer tests and program checkout procedures that can be performed prior to tactical employment of the system.

(4) Performance Monitoring and Fault Isolation. This subsection shall provide thorough explanations of the designed performance monitoring methods, and of procedures for isolating trouble during tactical employment. The content shall include appropriate

illustrations of whatever system instrumentation is provided for monitoring purposes, and of tables which will enhance such monitoring and fault isolation.

(5) Emergency Procedures. This subsection shall provide instructions pertinent to action that may be required to prevent damage to the computer and/or loss of the stored program in situations which might be anticipated during the course of tactical employment.

C. Organization of Contents.

(1) The contents of this section shall be organized in accordance with the sequence of requirements as set forth in B herein, unless otherwise authorized by cognizant Government authority.

(2) Instructions shall be contained under a separate, appropriately titled subheading.

SECTION 4 - DETECTION SUBSYSTEM OPERATING PROCEDURES

A. Purpose of the System. This section shall provide for each crewman/operator position, all of the instructions and procedures necessary for operation of the equipment comprising the detection subsystem.

B. Content Requirements.

(1) There shall be an introductory subsection containing pertinent explanatory or appropriate remarks concerning the section contents, use of tables, etc. It shall include, but is not limited to the following:

(a) A table, listing in one column each major component of the tracking subsystem by its standard nomenclature and common name; in a second column, the functional purpose of the component; in a third column, the source(s) of input to the component; in a fourth column, the output and destination thereof.

(b) A block diagram of the detection subsystem.

(c) An illustration, accurately detailed, which depicts and identifies the controls and indicators associated with operation of the detection subsystem equipments.

(d) A table which, in one column, provides the name of the control; in a second column identifies the equipment component to which it is associated; in a third column describes the control function. For ease of reference, the table shall be keyed to the illustration required in B(1)(c) above.

(2) A separate subsection shall be devoted to each mode of detection subsystem operation. Each subsystem shall include, but is not limited to, the following:

(a) Thorough explanations of the full range of system flexibility, capability and limitations in each mode.

(b) For each crewman/operator position, complete and detailed step-by-step explanations of the subsystem operating

procedures for each mode of operation; coverage shall include the normal, degraded and emergency procedures to be followed in each mode. Such operator instructions shall be conspicuously identified within the section.

(c) Illustrations, accurately detailed, which depict and identify the controls and indicators associated with operation of the detection subsystem equipments in the mode being described. The illustrations shall be keyed to the table required by B(1)(d), for ease of reference.

C. Organization of Contents

(1) Instructions for each crewman/operator shall be contained under a separate, appropriately titled subheading.

(2) The subsections shall provide an orderly, progressive explanation of the instructions and procedures for operation of the detection subsystem in an operational, training or maintenance environment.

(3) The mode of detection shall provide the primary heading for each subsection; instructions and procedures applicable to each of the crewman/operation positions shall be separated within each primary subsection under appropriately titled subheadings.

SECTION 5 - TRACKING SUBSYSTEM OPERATING PROCEDURES

A. Purpose of the Section. This section shall provide, for each crewman/operator position, all of the instructions and procedures necessary for operation of the equipment comprising the tracking subsystem, and to achieve target tracking in the operational or training environment.

B. Content Requirements

(1) There shall be an introductory subsection containing the contents of the section, use of tables, etc. The subsection shall include, but is not limited to, the following:

(a) A table, listing in one column each major component of the tracking subsystem by its standard nomenclature and name; in a second column, the functional purpose of the component; in a third column, the source(s) of input to the component; in a fourth column, the output and destination thereof.

(b) A block diagram of the detection subsystem configuration, identifying each major component by name and standard nomenclature.

(c) An accurately detailed illustration which depicts and identifies the controls and indicators associated with the navigation subsystem.

(d) A table which, in one column, provides the name of the control; in a second column, identifies the equipment component to which it is associated; in a third column describes the control function. The table shall be keyed to the illustration required in B(1)(c) above, for ease of reference.

(2) A separate subsection shall be devoted to each mode of tracking. Each subsection shall include, but is not limited to, the following:

(a) Thorough explanations of the full range of system flexibility, capability and limitations in each mode.

(b) For each crewman/operator position, complete and detailed step-by-step explanations of the subsystem operating procedures for each mode of operation; coverage shall include the normal, degraded and emergency procedures to be followed in each mode. These instructions shall be conspicuously identified within each section.

(c) Illustrations, accurately detailed, which depict and identify the controls and indicators associated with operation of the tracking subsystem equipments in the mode being described. The illustration shall be keyed to the table required by B(1)(d) above, for ease of reference.

C. Organization of Contents

(1) Instructions for each crewman/operator position shall be contained under a separate, appropriately titled subheading. The subsections shall provide an orderly, progressive, explanation of the instructions and procedures for operation of the tracking subsystems and for accomplishing target tracking (following) in an operational or training environment.

SECTION 6 - COMMUNICATION SUBSYSTEM OPERATING PROCEDURES

A. Purpose of the Section. This section shall provide complete and detailed instructions and procedures for operating and utilizing the communications subsystem.

B. Content Requirements

(1) There shall be an introductory subsection containing pertinent explanatory or appropriate remarks concerning the contents of the section, use of tables, etc. The subsection shall include, but is not limited to, the following:

(a) A block diagram of the communication subsystem configuration, identifying each major component by its name and nomenclature.

(b) A table, listing in one column each major component of the communication subsystem by its standard nomenclature and name; in a second column, the functional purpose of the component; in a third column, the source(s) of input to the component; in a fourth column, the output and destination thereof.

(c) An accurately detailed illustration which depicts and identifies the controls and indicators associated with operation of the communication subsystem.

(d) A table which, in one column, provides the name of the control; in a second column, identifies the equipment component to which it is associated; in a third column, describes the control function. The table shall be keyed to the illustration required in B(1)(c) above, for ease of reference.

(2) A separate subsection shall be devoted to each mode or method of communication. Each subsection shall include, but is not limited to, the following:

(a) Thorough explanations of the full range of system capability and equipment limitation in each mode.

(b) For each crewman/operator position, detailed descriptions and step-by-step instructions and procedures for the operation of the equipment.

Appendix 3

(c) A table, listing in one column the message types for each mode or method; in a second column, the message content requirements.

(d) An illustration, accurately detailed, which depicts and identifies the controls and indicators associated with each mode of operation. The illustration(s) shall be keyed to the table required by B(1)(d) above.

C. Organization of Contents

(1) The subsections shall provide an orderly, progressive explanation of the instructions and procedures for operation of the communication subsystem.

(2) The mode of communication shall provide the primary heading of each subsection; instructions and procedures applicable to each of the crewman/operator positions shall be separated within each primary subsection, under appropriately titled subheadings.

SECTION 7 - NAVIGATION SUBSYSTEM OPERATING PROCEDURES

A. Purpose of the Section. This section shall provide for each applicable crewman/operator position, all of the instructions and procedures necessary for operation of the navigation subsystem.

B. Content Requirements

(1) There shall be an introductory subsection containing pertinent explanatory or appropriate remarks concerning the section contents, use of tables, etc. It shall include, but is not limited to, the following:

(a) A block diagram of the navigation subsystem configuration, identifying each major component by its name and nomenclature.

(b) A table, listing in one column each major component of the communication subsystem by its name and standard nomenclature; in a second column, the functional purpose of the component; in a third column, the sources of input to the component; in a fourth column, the output and destination thereof.

(c) An illustration, accurately detailed, which depicts and identifies the controls and indicators associated with operation of the navigation subsystem.

(d) A table, which in one column provides the name of the control; in a second column, identifies the equipment component to which it is associated; in a third column, describes the control function. The table shall be keyed to the illustration required in B(1)(c) above, for ease of reference.

(2) A separate subsection shall be devoted to each mode of operation. Each subsection shall include, but is not limited to, the following:

(a) Thorough explanations of the full range of system capability and equipment limitations in each mode.

(b) Alignment procedures, normal, degraded and emergency.

(c) For each applicable crewman/operator position, detailed descriptions and step-by-step instructions and procedures for operation of the equipment.

(d) Illustrations, accurately detailed, which depict and identify the controls and indicators associated with operation of the navigation subsystem in the mode being described. The illustration shall be keyed to the table required by B(1)(d) above, for ease of reference.

C. Organization of Contents

(1) The section shall provide an orderly, progressive explanation of the instructions and procedures for operation of the navigation subsystem.

(2) The modes of operation, including alignment and shutdown, shall provide the primary headings of each subsection following the introduction. Instructions and procedures applicable to each of the crewman/operator positions shall be separated within each primary subsection under appropriately titled subheadings.

SECTION 8 - MISSION CONTROL PROCEDURES

A. Purpose of the Section. This section shall provide for each crewman/operator position all of the instructions and procedures necessary to perform the missions and tasks for which the tactical data system was designed.

B. Content Requirements

(1) An introductory subsection shall contain a listing of the missions and tasks within the system's capabilities.

(2) A subsection shall be devoted to each mission that the tactical data system is programmed to perform. Subsections shall also be devoted to each mission that can be performed by virtue of its compatibility with the basic tactical data system program.

(3) The content of each subsection shall include, but is not limited to the following:

(a) For each crewman/operator position, detailed descriptions and step-by-step instructions and procedures for performing each mission and/or operating the system equipment associated therewith, in all applicable modes. Coverage shall include operating procedures, in normal, degraded and emergency conditions, to be employed in each mode.

(b) A table, displaying in one column, accurate representations of the information display symbology used by the system in each condition, designation, assignment, mode and circumstance; in an opposing second column, the explanation of the symbology.

C. Organization of Contents

(1) The content shall be organized in such a manner that the mission type is the basic subsection heading, with the instructions and procedures for the various crewman/operator positions, separated within the primary section, under appropriately titled subheadings.

(2) Where possible, for each mission, the crewman/operator actions required for each crew position may be displayed in adjacent columns on the same page.

APPENDIX 4
TABLE OF CONTENTS

Page

SECTION 1 - PREFACE

- 1.1 Purpose of Manual
- 1.2 Scope of Manual
- 1.3 Applicability of Manual
- 1.4 Organization of Manual
- 1.5 Reference Documents

APPENDIX 4

FORMAT AND CONTENT REQUIREMENTS
FOR A TACTICAL DATA SYSTEM PROGRAM DESIGN MANUAL

APPENDIX 4
TABLE OF CONTENTS

	<u>Page</u>
SECTION 1 - PREFACE	1
1.1 Purpose of Manual	1
1.2 Scope of Manual	1
1.3 Applicability of Manual	1
1.4 Organization of Manual	1
1.5 Reference Documents	3
1.5.1 Referenced	3
1.5.2 Applicable	3

SECTION 1 - PREFACE

This section shall serve as an introduction to the manual, and shall be organized into subsections as indicated below.

1.1 Purpose of Manual. This subsection shall inform the reader of what the manual is about and for whom it is intended.

Sample Statement of Purpose. "The System Program Design Manual contains the primary source of detailed visibility into the design of the logic and decision functions as they are carried out in the operational routines of the _____ Tactical Data System. The Manual is directed toward computer system analysts, program designers, and programmers."

1.2 Scope of Manual. This subsection shall provide a brief description of the contents of the manual.

Sample Statement of Scope. "This manual contains the program flow diagrams, functional flow charts, and a narrative description of those routines which comprise the total operational computer program for the _____ Tactical Data System."

1.3 Applicability of Manual. This subsection shall provide information concerning the system complex, model(s), and configuration(s) to which the manual applies.

Sample Statement of Applicability. "The computer program documented in this manual is designated Model _____ and applies to _____ class/model of ship/aircraft number _____ and subsequent, configured with the _____ model computer in the _____ Tactical Data System."

1.4 Organization of Manual. This subsection shall describe the organization of the manual, which shall be organized in conformance to the format described below.

a. Major subdivisions of Manual. The manual shall be divided into sections, a section being devoted to the program design documentation of each operational program routine such as tracking, navigation, communications, etc., that is a part of the total operational computer program for the tactical data system.

b. Content Requirements. Each section shall contain the following listed program design documents pertinent to the operational program routine to which the section is devoted:

- (1) Functional Descriptions
- (2) Program Flow Diagrams
- (3) Functional Flow Charts

c. Organization of Contents

(1) The section shall be divided into subsections comprised of groups of three corresponding documents, arranged as follows:

- (a) Each Functional Description shall be followed in order by the corresponding Functional Flow Diagram.
- (b) Each Program Flow Diagram shall be followed in order by the corresponding Functional Flow Chart.

(2) The subsectional grouping of corresponding documents, assembled as indicated above, shall be numbered in such a manner that the primary number is that of the section containing the routine, and the secondary number corresponds to the subroutine sequence number indicated on the Program Flow Diagram.

(3) The following is an example of section organization:

SECTION 2 — TARGET DETECTION ROUTINE - Program Design
Documentation

2.1 Subroutine No. 1 - Search Phase

2.1.1 Functional Description

2.1.2 Program Flow Diagram

2.1.3 Functional Flow Chart

2.2 Subroutine No. 2 - Target Quality Check

2.2.1 Functional Description

Etc.

(4) Each section and subsection in the manual shall be separated by an appropriately labeled tab divider.

1.5 Reference Documents

1.5.1 Referenced. This subsection shall list those documents documents referenced or quoted, or from which illustrations, tables, or listings were extracted, in whole or in part.

1.5.2 Applicable. This subsection shall list those documents not referenced in the manual but applicable to the system or program for which the documentation has been produced. For example, the companion volumes and manuals of system documentation, while perhaps not referenced, would be applicable.

1.5.3 The listing of referenced and applicable documents under Sections 1.5.1 and 1.5.2 respectively, shall be in the following order.

(1) Specifications

- a. Military
- b. Federal

(2) Standards

- a. Military
- b. Federal
- c. Commercial

(3) Military Publications and Documents

- a. Manuals
- b. Handbooks
- c. Miscellaneous

(4) Commerical Publications and Documents

- a. Manuals
- b. Handbooks
- c. Miscellaneous

NOTE

In the event that no publications, documents, specifications or standards are referenced or applicable, the word "None" shall appear in the appropriate section.

APPENDIX 5
TABLE OF CONTENTS

Page

1	SECTION 1 - PREFACE
1.1	Purpose of Manual
1.2	Scope of Manual
1.3	Applicability of Manual
1.4	Organization of Manual
1.5	Reference Documents
1.5.1	1.5.1
1.5.2	1.5.2

APPENDIX 5
FORMAT AND CONTENT REQUIREMENTS
FOR A TACTICAL DATA SYSTEM
PROGRAM ASSEMBLY LISTINGS MANUAL

APPENDIX 5
TABLE OF CONTENTS

	<u>Page</u>
SECTION 1 — PREFACE	1
1.1 Purpose of Manual	1
1.2 Scope of Manual	1
1.3 Applicability of Manual	1
1.4 Organization of Manual	2
1.5 Reference Documents	3
1.5.1 Referenced	3
1.5.2 Applicable	3

SECTION 1 - PREFACE

This section shall serve as an introduction to the manual, and shall be organized into subsections as indicated below.

1.1 Purpose of Manual. This subsection shall inform the reader of what the manual is about and for whom it is intended.

Sample Statement of Purpose. "The System Program Assembly Listings Manual contains the documents which provide detailed visibility into the computational processes exercised by the computer in the _____ Tactical Data System, as it performs the operational program routines in response to system inputs. The documents in this manual pertain to the operational program routines only, and are intended for use by systems analysts, program designers, programmers and maintenance personnel."

1.2 Scope of Manual. This subsection shall provide a brief description of the contents of the manual.

Sample Statement of Scope. "This manual contains the following items which pertain only to the operational program routines for the _____ Tactical Data System:

- (1) Annotated Source Program
- (2) Memory Map
- (3) Core Allocation List
- (4) Label Reference List
- (5) Machine Generated Flow Chart
- (6) Procedure Summary
- (7) Module Summary Data
- (8) Wired Logic Listing (if any)"

1.3 Applicability of Manual. This subsection shall denote the system complex, model(s), and configuration(s) to which the manual applies.

Sample Statement of Applicability. "The computer program documented within is designaged as Model _____ and applies to _____ class/model of ship/aircraft number _____ and subsequent, configured with the model computer in the _____ Tactical Data System."

1.4 Organization of Manual. This subsection shall describe the organization of the manual, which shall be organized in conformance to the format described below:

(a) Major Subdivisions of the Manual. The manual shall be divided into sections, a section being devoted to the assembly listings for each operational program routine such as tracking, navigation, communications, etc.

(b) Content Requirements. Each section of the manual shall contain assembly listings composed of the following documents which pertain only to the operational program routine to which the section is assigned.

- (1) Annotated Source Program
- (2) Memory Map
- (3) Core Allocation List
- (4) Label Reference List
- (5) Machine Generated Flow Chart
- (6) Procedure Summary Data
- (7) Module Summary Data
- (8) Wired Logic Listing (if any)

(c) Organization of Contents

(1) The assembly listings in each section shall be divided into subsections, and titled and numbered to correspond to the Program Flow Diagram for the routine and subroutine being listed therein. The following is an example:

SECTION 2 — ASSEMBLY LISTING FOR TARGET DETECTION ROUTINES

2.1 Assembly Listing for Subroutine No. 1 - Search Phase

2.1.1 Annotated Source Program

2.1.2 Memory Map

2.1.3 Core Allocation List

2.1.4 Label Reference List

- 2.1.5 Machine Generated Flow Chart
- 2.1.6 Procedure Summary Data
- 2.1.7 Module Summary Data
- 2.1.8 Wired Logic Listing (if applicable)
- 2.2 Assembly Listing for Subroutine No. 2 - Target Quality Check
- Etc.

(2) Each section and subsection in the manual shall be separated by an appropriately labeled tab divider.

1.5 Reference Documents

1.5.1 Referenced. This subsection shall list those documents referenced or quoted, or from which illustrations, tables, or listings were extracted, in whole or in part.

1.5.2 Applicable. This subsection shall list those documents not referenced in the manual but applicable to the system or program for which the documentation has been produced. For example, the companion volumes and manuals of system documentation, while perhaps not referenced, would be applicable.

1.5.3 The listings of reference and applicable documents (per Sections 1.4.1 and 1.4.2) shall be in the following order:

(1) Specifications

- a. Military
- b. Federal

(2) Standards

- a. Military
- b. Federal
- c. Commerical

Appendix 5

(3) Military Publications and Documents

- a. Manuals
- b. Handbooks
- c. Miscellaneous

(4) Commercial Publications and Documents

- a. Manuals
- b. Handbooks
- c. Miscellaneous

NOTE

In the event that no publications, documents, specifications or standards are referenced or applicable, the word "None" shall appear in the appropriate section.

APPENDIX 6
TABLE OF CONTENTS

Page

SECTION I - PREFACE	1
1.1 Purpose of Manual	1
1.2 Scope of Manual	1
1.3 Applicability of Manual	1
1.4 Organization of Manual	1
1.5 Reference Documents	1

APPENDIX 6

FORMAT AND CONTENT REQUIREMENTS
FOR A TACTICAL DATA SYSTEM
PROGRAM MAINTENANCE MANUAL

APPENDIX 6
TABLE OF CONTENTS

	<u>Page</u>
SECTION 1 - PREFACE	1
1.1 Purpose of Manual	1
1.2 Scope of Manual	1
1.3 Applicability of Manual	1
1.4 Organization of Manual	1
1.5 Reference Documents	3
1.5.1 Referenced	3
1.5.2 Applicable	3

SECTION 1 - PREFACE

This section shall serve as an introduction to the manual, and shall be organized into subsections as indicated below.

1.1 Purpose of Manual. This subsection shall inform the reader of what the manual is about and for whom it is intended.

Sample Statement of Purpose. "The System Program Maintenance Manual contains the documents which provide detailed visibility into the design structure and processing methods of the test, utility and maintenance routines used with the _____ Tactical Data System. The manual is directed toward systems analysts, program designers, programmers and maintenance personnel."

1.2 Scope of Manual. This subsection shall provide a brief description of the contents of the manual.

Sample Statement of Scope. "This manual contains the following documents pertaining only to the test routines used to trace, locate and diagnose programming errors, and for utility routines used for data extraction, checking, and reduction:

- (1) Functional Descriptions
- (2) Program Flow Diagrams
- (3) Functional Flow Charts
- (4) Assembly Listings."

1.3 Applicability of Manual. This subsection shall denote the system complex, model(s), and configuration(s) to which the manual applies.

Sample Statement of Applicability. "The computer program documented within this manual applies to _____ class/model of ship/aircraft number _____ and subsequent, configured with the _____ model computer in the Tactical Data Subsystem."

1.4 Organization of Manual. This subsection shall describe the organization of the manual, which shall be organized in conformance with the format described below.

(1) Major Subdivisions of the Manual. The manual shall be divided into two parts, Part I being devoted to the documentation

for each test routine and Part II to the documentation pertaining to the utility routines. Each Part shall be further subdivided into sections and subsections.

(2) Organization of Contents

(a) Part I of the manual shall be divided into sections; each section shall have as its heading the name of the operational program routine that it is designed to test, and shall be numbered in accordance with the number on the corresponding Program Flow Diagram. If no program flow diagram is available for the test routine, then the number of the applicable functional description shall be used.

(b) The complete documentation package for each test routine shall be further divided into subsections, titled and numbered to correspond to the operational program routine to which they apply, as in the following example:

SECTION 2 - TEST ROUTINE DOCUMENTATION FOR TARGET
DETECTION ROUTINE

2.1 Test Routine No. 1

2.1.1 Functional Description

2.1.2 Program Flow Diagram

2.1.3 Functional Flow Chart

2.1.4 Assembly Listings

2.1.4.1 Annotated Source Program

2.1.4.2 Memory Map

2.1.4.3 Core Allocation List

2.1.4.4 Label Reference List

2.1.4.5 Machine Generated Flow Chart

2.1.4.6 Procedure Summary Data

2.1.4.7 Module Summary Data

2.1.4.8 Wired Logic Listings (if any)

(c) Part II of the manual shall contain the documentation for the utility routines. Each utility routine shall be assigned a separate section which shall contain a complete documentation package subdivided into subsections as described in item (2)(b), above.

(c) Each section and subsection in the manual shall be separated by an appropriately labeled tab divider.

1.5 Reference Documents

1.5.1 Referenced. This subsection shall contain a listing of those documents referenced or quoted, or from which illustrations, tables, or listings were extracted, in whole or in part.

1.5.2 Applicable. This subsection shall contain a listing of those documents not referenced in the manual but applicable to the system or program for which the documentation has been produced. For example, the companion volumes and manuals of system documentation, while perhaps not referenced, would be applicable.

1.5.3 The listing of reference and applicable documents (per Sections 1.5.1 and 1.5.2) shall be in the following order:

(1) Specifications

- a. Military
- b. Federal

(2) Standards

- a. Military
- b. Federal
- c. Commerical

(3) Military Publications and Documents

- a. Manuals
- b. Handbooks
- c. Miscellaneous

(4) Commercial Publications and Documents

- a. Manuals
- b. Handbooks
- c. Miscellaneous

NOTE

In the event that no publications, documents, specifications or standards are referenced or applicable, the word "None" shall appear in the appropriate section.

APPENDIX 7
TABLE OF CONTENTS

Page

SECTION 1 - PREFACE	1
1.1 Purpose of the Manual	1
1.2 Scope of the Manual	1
1.3 Applicability	1
1.4 Reference Documents	1
1.5 Explanation of Terms	1

SECTION 2 - COMPUTER DESIGNATION AND	2
2.1 Purpose of the Section	2
2.2 Content Requirements	2
2.3 Organization of Contents	2

APPENDIX 7
FORMAT AND CONTENT REQUIREMENTS FOR
A TACTICAL DATA SYSTEM PROGRAMMER'S
REFERENCE MANUAL

SECTION 3 - ASSEMBLY INSTRUCTIONS	3
3.1 Purpose of the Section	3
3.2 Content Requirements	3
3.3 Organization of Contents	3

SECTION 4 - INSTRUCTIONS FOR INTERPRETER PROGRAM	4
4.1 Purpose of the Section	4
4.2 Content Requirements	4
4.3 Organization of Contents	4

SECTION 5 - INSTRUCTIONS FOR PREPARATION AND USE OF	5
FUNCTIONAL TEST PROGRAMS	5
5.1 Purpose of the Section	5
5.2 Content Requirements	5
5.3 Organization of Contents	5

SECTION 6 - INSTRUCTIONS FOR THE PREPARATION AND USE	6
OF UTILITY ROUTINES	6
6.1 Purpose of the Section	6
6.2 Content Requirements	6
6.3 Organization of Contents	6

SECTION 7 - LIBRARY ROUTINES	7
7.1 Purpose of the Section	7
7.2 Content Requirements	7
7.3 Organization of Contents	7

SECTION 8 - USEFUL MATHEMATICAL TABLES	8
8.1 Purpose of the Section	8
8.2 Content Requirements	8

APPENDIX 7

TABLE OF CONTENTS

	<u>Page</u>
SECTION 1 - PREFACE	1
1.1 Purpose of the Manual	1
1.2 Scope of the Manual	1
1.3 Applicability	2
1.4 Reference Documents	2
1.5 Explanation of Terms	3
SECTION 2 - COMPUTER DESCRIPTION, ORGANIZATION AND INSTRUCTIONS	4
A. Purpose of the Section	4
B. Content Requirements	4
C. Organization of Contents	6
SECTION 3 - ASSEMBLY INSTRUCTIONS	7
A. Purpose of the Section	7
B. Content Requirements	7
C. Organization of Contents	7
SECTION 4 - INSTRUCTIONS FOR INTERPRETER PROGRAM PREPARATION	8
A. Purpose of the Section	8
B. Content Requirements	8
C. Organization of Contents	8
SECTION 5 - INSTRUCTIONS FOR PREPARATION AND USE OF FUNCTIONAL TEST PROGRAMS	9
A. Purpose of the Section	9
B. Content Requirements	9
C. Organization of Contents	9
SECTION 6 - INSTRUCTIONS FOR THE PREPARATION AND USE OF UTILITY ROUTINES	10
A. Purpose of the Section	10
B. Content Requirements	10
C. Organization of Contents	10
SECTION 7 - LIBRARY ROUTINES	11
A. Purpose of the Section	11
B. Content Requirements	11
C. Organization of Contents	11
SECTION 8 - USEFUL MATHEMATICAL TABLES	12
A. Purpose of the Section	12
B. Content Requirements	12

SECTION 1 - PREFACE

This section shall serve as an introduction to the manual, and shall be organized as indicated below.

1.1 Purpose of Manual. This subsection shall inform the reader of what the manual is about and for whom it is intended.

Sample Statement of Purpose. "The purpose of the manual is to present, under one cover, all the information required for a programmer to convert from the diagrammed structure of the operational sequences of a computer program to the instruction code for writing on the input medium to the system's computer.

The manual is directed toward the digital computer programmers who are required to prepare source programs for the operational, test, maintenance, simulation and interpreter routines for the _____ Tactical Data System.

The manual shall be written so that it can also be used in the training of college-level personnel who have received special system orientation; it shall combine the features of a basic programming manual and a programmer's reference manual."

1.2 Scope of Manual. This subsection provides a brief description of the contents of the manual.

Sample Statement of Scope. "This manual contains a description of the _____ computer and explains the procedures, rules, techniques, instructions and conventions for preparation and use of the following:

- (a) Assembly programs.
- (b) Object programs.
- (c) Simulation (interpreter) programs.
- (d) Functional test programs.
- (e) Utility programs.
- (f) Library routines.

In addition to the foregoing, this manual contains the following useful tables:

- (a) Powers of two.
- (b) Octal-decimal integer conversion.
- (c) Octal-decimal fraction conversion.
- (d) Hexadecimal-decimal conversion."

Appendix 7

1.3 Applicability of Manual. This subsection shall denote the specific system complex, hardware, model, and configuration to which the manual applies.

Sample Statement of Applicability. "The information in this manual is applicable to the _____ Tactical Data System containing the _____ computer, and those previously manufactured computers that are subsequently updated to the _____ model configuration."

1.4 Reference Documents

1.4.1 Referenced. This subsection shall list those documents referenced, quoted, or from which illustrations, tables or listings were extracted, in whole or in part.

1.4.2 Applicable. This subsection shall list those documents not referenced in the manual but applicable to the system or program for which the documentation has been produced. For example, the companion volumes and manuals of system documentation, while perhaps not referenced, would be applicable.

1.4.3 Listing Order. The listing of referenced and applicable documents (per 1.4.1 and 1.4.2) shall be in the following order:

(1) Specifications

- a. Milita.
- b. Federal

(2) Standards

- a. Military
- b. Federal
- c. Commercial

(3) Military Publications and Documents

- a. Manuals
- b. Handbooks
- c. Miscellaneous

(4) Commercial Publications and Documents

- a. Manuals
- b. Handbooks
- c. Miscellaneous

NOTE

In the event that no publications, documents, specifications, or standards are referenced or applicable, the word "None" shall appear in the appropriate section.

1.5 Explanation of Terms. This subsection shall contain an alphabetical listing of the terms peculiar or unique to this manual, with a definition of those terms as used on context.

SECTION 2 — COMPUTER DESCRIPTION, ORGANIZATION AND INSTRUCTIONS

A. Purpose of Section. This section shall contain all information necessary to provide a programmer an understanding of the computing device and the programming methodology.

B. Content Requirements

(1) General Machine Description. A subsection shall contain a description of the computer and its basic characteristics in general terms. The description should provide introductory information sufficient to satisfy initial inquiries such as "What kind of a computing device is this? What are its basic characteristics? Is it unique? If so, in what way? What is its tactical purpose?"

(2) Computer Organization

(a) A subsection shall provide a general description and block diagram of the functional structure of the computer. The intent will be to provide the programmer with general descriptions of the modular organization, readout and control equipments, and interface with its data sensor(s) and other peripheral devices. The descriptions should be organized in the following order:

- 1) Instruction Section
- 2) Memory Section
- 3) Arithmetic Section
- 4) Program/Routine Priority Control Section
- 5) Input/Output Section
- 6) Other

(b) While any unique characteristic of the computer itself may justify deviation from the foregoing order, it is intended that the functional descriptions be organized in such a sequence that each subsection facilitates an understanding of preceding information.

(3) Computer Arithmetic. A subsection shall provide details concerning computer manipulation of binary data in performing mathematical operations. The subsection shall be organized to provide details of the following:

- (a) Number representations
- (b) Addition examples
- (c) Subtraction examples
- (d) Multiplication
- (e) Division
- (f) Error conditions
- (g) Special conditions
- (h) Library routines

(4) Computer Instructions. A subsection shall contain complete descriptions of instructions, word formats, address procedures, options or modes, notation symbology and definitions, coding sheets and any other special or unique procedures, and methods or actions applicable to the computer language. The order of presentation shall be similar to that in the following outline.

- (a) Word Formats
- (b) Address Options or Modes
- (c) Instruction Descriptions
 - 1) Data Transmission Instruction
 - 2) Arithmetic Instructions
 - 3) Logic Instructions
 - 4) Shift Instructions
 - 5) Transfer Instructions
 - 6) Jump Instructions
 - 7) I/O Instructions
 - 8) Special Instructions.

Appendix 7

(d) Table of Notation Symbols with Definitions. An example of the table is as follows:

<u>Symbol</u>	<u>Definition</u>
→	Is transferred to
()	Contents of memory location addressed by word within the parentheses
	Absolute value

(e) Table of Computer Instructions. This table should have columnar headings as follows:

- 1) Instruction Name
- 2) Function Code
- 3) Mnemonic Code
- 4) Description
- 5) Miscellaneous
- 6) Mode Options
- 7) Execution Time (in microseconds)

(5) Computer Operation

(a) A subsection shall describe how the computer accomplishes the processing of data; i.e., storage, retrieval, arithmetic and decision functions, and timing constraints. The intent is to present the programmer with all details of the computer's operating characteristics and provide the required familiarity with its procedures in order to structure an operable program. Insofar as practicable, the subsections shall be titled and sequenced as in item 2B(2).

C. Organization of Contents. Unless deviation can be justified and is approved by cognizant authority, the contents of this section shall be organized in accordance with the foregoing sequence of items 2B(1) through 2B(5).

SECTION 3 - ASSEMBLY INSTRUCTIONS

A. Purpose of the Section. This section shall provide the information necessary to the preparation of assembly programs for the computer.

B. Content Requirements. All applicable instructions, rules, procedures, operations, language formats, assembly listings, error indications, and equipment requirements shall be described and appropriately illustrated.

(1) Subsections shall explain rules for the preparation of subroutines, coding forms, for reading assembler listings and diagnostics, and for monitor operations, storage allocation, and pseudo operations.

C. Organization of Contents. This section shall be organized into subsections, the sequence of which will facilitate progressive understanding.

SECTION 4 - INSTRUCTIONS FOR INTERPRETER PROGRAM PREPARATION

A. Purpose of Section. This section shall describe the steps that must be taken to simulate the execution of the TDS computer source language program on a different computer.

B. Content Requirements. The section shall include (but not be limited to) appropriate illustrations, tables, and descriptions of the following:

- (1) Program Description and Block Diagram.
- (2) Interpreter Inputs
 - (a) Control Cards (include examples)
 - (b) _____ Computer Program Input
 - (c) Interpreter Input Data Generator.
- (3) Outputs
 - (a) Object deck generation (include examples)
 - (b) Peripheral Device Outputs (include examples)
 - (c) Listings and Diagnostics (include examples).

C. Organization of Contents. The section shall be organized into subsections as indicated by the foregoing format, unless justifiable deviations are approved by the cognizant Government authority.

SECTION 5 - INSTRUCTIONS FOR PREPARATION AND USE OF FUNCTIONAL TEST PROGRAMS

A. Purpose of the Section. The purpose of this section is to provide the instructions, descriptions, illustrations and method examples for producing the computer program routines to check computer modular continuity, hardware to software interface, input/output errors and fault isolation.

B. Content Requirements. For each of the test routines there shall be a subsection devoted to the following:

- (1) A description of its functional purpose.
- (2) Mnemonic codes and their definitions.
- (3) Instruction requirements and definitions.
- (4) Timing requirements.
- (5) Implementation procedures.
- (6) Accuracy.
- (7) Examples and illustrations.
- (8) Tables designed for each reference.

C. Organization of Contents. The instructions for the development of each type or category of test routine shall be contained within a separate subsection. Where redundancy would be conspicuously significant if the procedures for generating different types of test routines were categorically separated, they may be combined under a single major subheading such as "Memory and Arithmetic Tests."

SECTION 6 - INSTRUCTIONS FOR THE PREPARATION AND USE OF UTILITY ROUTINES

A. Purpose of the Section. The purpose of this section is to provide an understanding of the utility routines available for computer use, and of methods for their implementation.

B. Content Requirements

(1) Subsections shall be devoted to routines in the following categories:

(a) Data Extraction Routines - used to transfer information from memory to a selected peripheral device and vice versa;

(b) Test Routines - used to trace, locate and diagnose programming errors;

(c) Checking Routines - used to examine program data, tapes and punched EAM cards for errors;

(d) Data Reduction Routines.

(2) For each of the utility routines, a subsection shall be devoted to the following:

(a) A description defining its functional purpose

(b) Mnemonic codes and their definitions

(c) Instruction requirements and definitions

(d) Timing requirements

(e) Accuracy

(f) Implementation procedures

(g) Examples and illustrations

(h) Appropriate tables.

C. Organization of Contents. The instructions for the development of each type or category of utility routine shall be contained within a separate subsection. Where redundancy would be conspicuously significant if the procedures for developing different types of test routines were categorically separated, they may be combined under a single major subheading.

SECTION 7 - LIBRARY ROUTINES

A. Purpose of the Section. The purpose of this section is to furnish the programmer with useful mathematical routines designed for incorporation as required into any part of the program.

B. Content Requirements

(1) The section on library routines shall include (but is not limited to) routines for the performance of the following mathematical functions:

- (a) Sine and arc sine.
- (b) Cosine and arc cosine.
- (c) Tangent and arc tangent.
- (d) Square root.

(2) For each of the library routines, a subsection shall be devoted to the following:

- (a) A description defining its functional purpose.
- (b) Method of solution.
- (c) Mnemonic codes and their definitions.
- (d) Instruction requirements and their definitions.
- (e) Timing requirements.
- (f) Accuracy.
- (g) Implementation procedures.
- (h) Examples and illustrations.
- (i) Appropriate tables.

C. Organization of Contents. The sequence of presentation shall, insofar as practicable, progress from the least to the most complex routine. Repetition of detail is not to be avoided at the sacrifice of ease and convenience of utilization.

SECTION 8 - USEFUL MATHEMATICAL TABLES

A. Purpose of the Section. This section shall include progression and conversion tables, for the purpose of eliminating routine calculations by the individual programmer.

B. Content Requirements

(1) Required Tables. This section shall include, but not be limited to, the following tables:

- (a) Powers of Two.
- (b) Octal-Decimal Integer Conversion Table (between the octal limits of 0 and 7777 with extrapolation examples).
- (c) Octal-Decimal Fraction Conversion Table (between the octal limits of .0 and .000777).
- (d) Hexadecimal-Decimal Conversion Table.

(2) Preparation of Tables. The tables listed in B(1) above shall be prepared in accordance with the following examples, Tables 1 through 4.

TABLE 1
TABLE OF POWERS OF TWO

1	0	1.0
2	1	0.5
4	2	0.25
8	3	0.125
16	4	0.062 5
32	5	0.031 25
64	6	0.015 625
128	7	0.007 812 5
256	8	0.003 906 25
512	9	0.001 953 125
1 024	10	0.000 976 562 5
2 048	11	0.000 488 281 25
4 096	12	0.000 244 140 625
8 192	13	0.000 122 070 312 5
16 384	14	0.000 061 035 156 25
32 768	15	0.000 030 517 578 125
65 536	16	0.000 015 258 789 062 5
131 072	17	0.000 007 629 394 531 25
262 144	18	0.000 003 814 697 265 625
524 288	19	0.000 001 907 348 632 812 5
1 048 576	20	0.000 000 953 674 316 406 25
2 097 152	21	0.000 000 476 837 158 203 125
4 194 304	22	0.000 000 238 418 579 101 562 5
8 388 608	23	0.000 000 119 209 289 550 781 25
16 777 216	24	0.000 000 059 604 644 775 390 625
33 554 432	25	0.000 000 029 802 322 387 695 312 5
67 108 864	26	0.000 000 014 901 161 193 847 656 25
134 217 728	27	0.000 000 007 450 580 596 923 828 125
268 435 456	28	0.000 000 003 725 290 298 461 914 062 5
536 870 912	29	0.000 000 001 862 645 149 230 957 031 25
1 073 741 824	30	0.000 000 000 931 322 574 615 478 515 625
2 147 483 648	31	0.000 000 000 465 661 287 307 739 257 812 5
4 294 967 296	32	0.000 000 000 232 830 643 653 869 628 906 25
8 589 934 592	33	0.000 000 000 116 415 321 826 934 814 453 125
17 179 869 184	34	0.000 000 000 058 207 660 913 467 407 226 562 5
34 359 738 368	35	0.000 000 000 029 103 830 456 733 703 613 281 25
68 719 476 736	36	0.000 000 000 014 551 915 228 366 851 806 640 625
137 438 953 472	37	0.000 000 000 007 275 957 614 183 425 903 320 312 5
274 877 906 944	38	0.000 000 000 003 637 978 807 091 712 951 660 156 25
549 755 813 888	39	0.000 000 000 001 818 989 403 545 856 475 830 078 125
1 099 511 627 766	40	0.000 000 000 000 909 494 701 772 928 237 915 039 062 5

TABLE 2
OCTAL-DECIMAL INTEGER CONVERSION TABLE

0000 0000
to to
0777 0511
(Octal) (Decimal)

Octal Decimal
10000 - 4096
20000 - 8192
30000 - 12288
40000 - 16384
50000 - 20480
60000 - 24576
70000 - 28672

	0	1	2	3	4	5	6	7
0000	0000	0001	0002	0003	0004	0005	0006	0007
0010	0008	0009	0010	0011	0012	0013	0014	0015
0020	0016	0017	0018	0019	0020	0021	0022	0023
0030	0024	0025	0026	0027	0028	0029	0030	0031
0040	0032	0033	0034	0035	0036	0037	0038	0039
0050	0040	0041	0042	0043	0044	0045	0046	0047
0060	0048	0049	0050	0051	0052	0053	0054	0055
0070	0056	0057	0058	0059	0060	0061	0062	0063
0100	0064	0065	0066	0067	0068	0069	0070	0071
0110	0072	0073	0074	0075	0076	0077	0078	0079
0120	0080	0081	0082	0083	0084	0085	0086	0087
0130	0088	0089	0090	0091	0092	0093	0094	0095
0140	0096	0097	0098	0099	0100	0101	0102	0103
0150	0104	0105	0106	0107	0108	0109	0110	0111
0160	0112	0113	0114	0115	0116	0117	0118	0119
0170	0120	0121	0122	0123	0124	0125	0126	0127
0200	0128	0129	0130	0131	0132	0133	0134	0135
0210	0136	0137	0138	0139	0140	0141	0142	0143
0220	0144	0145	0146	0147	0148	0149	0150	0151
0230	0152	0153	0154	0155	0156	0157	0158	0159
0240	0160	0161	0162	0163	0164	0165	0166	0167
0250	0168	0169	0170	0171	0172	0173	0174	0175
0260	0176	0177	0178	0179	0180	0181	0182	0183
0270	0184	0185	0186	0187	0188	0189	0190	0191
0300	0192	0193	0194	0195	0196	0197	0198	0199
0310	0200	0201	0202	0203	0204	0205	0206	0207
0320	0208	0209	0210	0211	0212	0213	0214	0215
0330	0216	0217	0218	0219	0220	0221	0222	0223
0340	0224	0225	0226	0227	0228	0229	0230	0231
0350	0232	0233	0234	0235	0236	0237	0238	0239
0360	0240	0241	0242	0243	0244	0245	0246	0247
0370	0248	0249	0250	0251	0252	0253	0254	0255

	0	1	2	3	4	5	6	7
0400	0256	0257	0258	0259	0260	0261	0262	0263
0410	0264	0265	0266	0267	0268	0269	0270	0271
0420	0272	0273	0274	0275	0276	0277	0278	0279
0430	0280	0281	0282	0283	0284	0285	0286	0287
0440	0288	0289	0290	0291	0292	0293	0294	0295
0450	0296	0297	0298	0299	0300	0301	0302	0303
0460	0304	0305	0306	0307	0308	0309	0310	0311
0470	0312	0313	0314	0315	0316	0317	0318	0319
0500	0320	0321	0322	0323	0324	0325	0326	0327
0510	0328	0329	0330	0331	0332	0333	0334	0335
0520	0336	0337	0338	0339	0340	0341	0342	0343
0530	0344	0345	0346	0347	0348	0349	0350	0351
0540	0352	0353	0354	0355	0356	0357	0358	0359
0550	0360	0361	0362	0363	0364	0365	0366	0367
0560	0368	0369	0370	0371	0372	0373	0374	0375
0570	0376	0377	0378	0379	0380	0381	0382	0383
0600	0384	0385	0386	0387	0388	0389	0390	0391
0610	0392	0393	0394	0395	0396	0397	0398	0399
0620	0400	0401	0402	0403	0404	0405	0406	0407
0630	0408	0409	0410	0411	0412	0413	0414	0415
0640	0416	0417	0418	0419	0420	0421	0422	0423
0650	0424	0425	0426	0427	0428	0429	0430	0431
0660	0432	0433	0434	0435	0436	0437	0438	0439
0670	0440	0441	0442	0443	0444	0445	0446	0447
0700	0448	0449	0450	0451	0452	0453	0454	0455
0710	0456	0457	0458	0459	0460	0461	0462	0463
0720	0464	0465	0466	0467	0468	0469	0470	0471
0730	0472	0473	0474	0475	0476	0477	0478	0479
0740	0480	0481	0482	0483	0484	0485	0486	0487
0750	0488	0489	0490	0491	0492	0493	0494	0495
0760	0496	0497	0498	0499	0500	0501	0502	0503
0770	0504	0505	0506	0507	0508	0509	0510	0511

1000 0512
to to
1777 1023
(Octal) (Decimal)

	0	1	2	3	4	5	6	7
1000	0512	0513	0514	0515	0516	0517	0518	0519
1010	0520	0521	0522	0523	0524	0525	0526	0527
1020	0528	0529	0530	0531	0532	0533	0534	0535
1030	0536	0537	0538	0539	0540	0541	0542	0543
1040	0544	0545	0546	0547	0548	0549	0550	0551
1050	0552	0553	0554	0555	0556	0557	0558	0559
1060	0560	0561	0562	0563	0564	0565	0566	0567
1070	0568	0569	0570	0571	0572	0573	0574	0575
1100	0576	0577	0578	0579	0580	0581	0582	0583
1110	0584	0585	0586	0587	0588	0589	0590	0591
1120	0592	0593	0594	0595	0596	0597	0598	0599
1130	0600	0601	0602	0603	0604	0605	0606	0607
1140	0608	0609	0610	0611	0612	0613	0614	0615
1150	0616	0617	0618	0619	0620	0621	0622	0623
1160	0624	0625	0626	0627	0628	0629	0630	0631
1170	0632	0633	0634	0635	0636	0637	0638	0639
1200	0640	0641	0642	0643	0644	0645	0646	0647
1210	0648	0649	0650	0651	0652	0653	0654	0655
1220	0656	0657	0658	0659	0660	0661	0662	0663
1230	0664	0665	0666	0667	0668	0669	0670	0671
1240	0672	0673	0674	0675	0676	0677	0678	0679
1250	0680	0681	0682	0683	0684	0685	0686	0687
1260	0688	0689	0690	0691	0692	0693	0694	0695
1270	0696	0697	0698	0699	0700	0701	0702	0703
1300	0704	0705	0706	0707	0708	0709	0710	0711
1310	0712	0713	0714	0715	0716	0717	0718	0719
1320	0720	0721	0722	0723	0724	0725	0726	0727
1330	0728	0729	0730	0731	0732	0733	0734	0735
1340	0736	0737	0738	0739	0740	0741	0742	0743
1350	0744	0745	0746	0747	0748	0749	0750	0751
1360	0752	0753	0754	0755	0756	0757	0758	0759
1370	0760	0761	0762	0763	0764	0765	0766	0767

	0	1	2	3	4	5	6	7
1400	0768	0769	0770	0771	0772	0773	0774	0775
1410	0776	0777	0778	0779	0780	0781	0782	0783
1420	0784	0785	0786	0787	0788	0789	0790	0791
1430	0792	0793	0794	0795	0796	0797	0798	0799
1440	0800	0801	0802	0803	0804	0805	0806	0807
1450	0808	0809	0810	0811	0812	0813	0814	0815
1460	0816	0817	0818	0819	0820	0821	0822	0823
1470	0824	0825	0826	0827	0828	0829	0830	0831
1500	0832	0833	0834	0835	0836	0837	0838	0839
1510	0840	0841	0842	0843	0844	0845	0846	0847
1520	0848	0849	0850	0851	0852	0853	0854	0855
1530	0856	0857	0858	0859	0860	0861	0862	0863
1540	0864	0865	0866	0867	0868	0869	0870	0871
1550	0872	0873	0874	0875	0876	0877	0878	0879
1560	0880	0881	0882	0883	0884	0885	0886	0887
1570	0888	0889	0890	0891	0892	0893	0894	0895
1600	0896	0897	0898	0899	0900	0901	0902	0903
1610	0904	0905	0906	0907	0908	0909	0910	0911
1620	0912	0913	0914	0915	0916	0917	0918	0919
1630	0920	0921	0922	0923	0924	0925	0926	0927
1640	0928	0929	0930	0931	0932	0933	0934	0935
1650	0936	0937	0938	0939	0940	0941	0942	0943
1660	0944	0945	0946	0947	0948	0949	0950	0951
1670	0952	0953	0954	0955	0956	0957	0958	0959
1700	0960	0961	0962	0963	0964	0965	0966	0967
1710	0968	0969	0970	0971	0972	0973	0974	0975
1720	0976	0977	0978	0979	0980	0981	0982	0983
1730	0984	0985	0986	0987	0988	0989	0990	0991
1740	0992	0993	0994	0995	0996	0997	0998	0999
1750	1000	1001	1002	1003	1004	1005	1006	1007
1760	1008	1009	1010	1011	1012	1013	1014	1015
1770	1016	1017	1018	1019	1020	1021	1022	1023

TABLE 3
OCTAL-DECIMAL FRACTION CONVERSION TABLE

OCTAL	DEC.	OCTAL	DEC.	OCTAL	DEC.	OCTAL	DEC.
.000	.000000	.100	.125000	.200	.250000	.300	.375000
.001	.001953	.101	.126953	.201	.251953	.301	.376953
.002	.003906	.102	.128906	.202	.253906	.302	.378906
.003	.005859	.103	.130859	.203	.255859	.303	.380859
.004	.007812	.104	.132812	.204	.257812	.304	.382812
.005	.009765	.105	.134765	.205	.259765	.305	.384765
.006	.011718	.106	.136718	.206	.261718	.306	.386718
.007	.013671	.107	.138671	.207	.263671	.307	.388671
.010	.015625	.110	.140625	.210	.265625	.310	.390625
.011	.017578	.111	.142578	.211	.267578	.311	.392578
.012	.019531	.112	.144531	.212	.269531	.312	.394531
.013	.021484	.113	.146484	.213	.271484	.313	.396484
.014	.023437	.114	.148437	.214	.273437	.314	.398437
.015	.025390	.115	.150390	.215	.275390	.315	.400390
.016	.027343	.116	.152343	.216	.277343	.316	.402343
.017	.029296	.117	.154296	.217	.279296	.317	.404296
.020	.031250	.120	.156250	.220	.281250	.320	.406250
.021	.033203	.121	.158203	.221	.283203	.321	.408203
.022	.035156	.122	.160156	.222	.285156	.322	.410156
.023	.037109	.123	.162109	.223	.287109	.323	.412109
.024	.039062	.124	.164062	.224	.289062	.324	.414062
.025	.041015	.125	.166015	.225	.291015	.325	.416015
.026	.042968	.126	.167968	.226	.292968	.326	.417968
.027	.044921	.127	.169921	.227	.294921	.327	.419921
.030	.046875	.130	.171875	.230	.296875	.330	.421875
.031	.048828	.131	.173828	.231	.298828	.331	.423828
.032	.050781	.132	.175781	.232	.300781	.332	.425781
.033	.052734	.133	.177734	.233	.302734	.333	.427734
.034	.054687	.134	.179687	.234	.304687	.334	.429687
.035	.056640	.135	.181640	.235	.306640	.335	.431640
.036	.058593	.136	.183593	.236	.308593	.336	.433593
.037	.060546	.137	.185546	.237	.310546	.337	.435546
.040	.062500	.140	.187500	.240	.312500	.340	.437500
.041	.064453	.141	.189453	.241	.314453	.341	.439453
.042	.066406	.142	.191406	.242	.316406	.342	.441406
.043	.068359	.143	.193359	.243	.318359	.343	.443359
.044	.070312	.144	.195312	.244	.320312	.344	.445312
.045	.072265	.145	.197265	.245	.322265	.345	.447265
.046	.074218	.146	.199218	.246	.324218	.346	.449218
.047	.076171	.147	.201171	.247	.326171	.347	.451171
.050	.078125	.150	.203125	.250	.328125	.350	.453125
.051	.080078	.151	.205078	.251	.330078	.351	.455078
.052	.082031	.152	.207031	.252	.332031	.352	.457031
.053	.083984	.153	.208984	.253	.333984	.353	.458984
.054	.085937	.154	.210937	.254	.335937	.354	.460937
.055	.087890	.155	.212890	.255	.337890	.355	.462890
.056	.089843	.156	.214843	.256	.339843	.356	.464843
.057	.091796	.157	.216796	.257	.341796	.357	.466796
.060	.093750	.160	.218750	.260	.343750	.360	.468750
.061	.095703	.161	.220703	.261	.345703	.361	.470703
.062	.097656	.162	.222656	.262	.347656	.362	.472656
.063	.099609	.163	.224609	.263	.349609	.363	.474609
.064	.101562	.164	.226562	.264	.351562	.364	.476562
.065	.103515	.165	.228515	.265	.353515	.365	.478515
.066	.105468	.166	.230468	.266	.355468	.366	.480468
.067	.107421	.167	.232421	.267	.357421	.367	.482421
.070	.109375	.170	.234375	.270	.359375	.370	.484375
.071	.111328	.171	.236328	.271	.361328	.371	.486328
.072	.113281	.172	.238281	.272	.363281	.372	.488281
.073	.115234	.173	.240234	.273	.365234	.373	.490234
.074	.117187	.174	.242187	.274	.367187	.374	.492187
.075	.119140	.175	.244140	.275	.369140	.375	.494140
.076	.121093	.176	.246093	.276	.371093	.376	.496093
.077	.123046	.177	.248046	.277	.373046	.377	.498046

TABLE 4
HEXADECIMAL-DECIMAL CONVERSION TABLE

The table in this appendix provides for direct conversion of decimal and hexadecimal numbers in these ranges:

HEXADECIMAL
000 to FFF

DECIMAL
0000 to 4095

For numbers outside the range of the table, add the following values to the table figures:

HEXADECIMAL
1000
2000
3000

DECIMAL
4096
8192
12288

HEXADECIMAL

4000
5000
6000
7000
8000
9000
A000
B000
C000
D000
E000
F000

DECIMAL

16384
20480
24576
28672
32768
36864
40960
45056
49152
53248
57344
61440

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
000	0000	0001	0002	0003	0004	0005	0006	0007	0008	0009	0010	0011	0012	0013	0014	0015
010	0016	0017	0018	0019	0020	0021	0022	0023	0024	0025	0026	0027	0028	0029	0030	0031
020	0032	0033	0034	0035	0036	0037	0038	0039	0040	0041	0042	0043	0044	0045	0046	0047
030	0048	0049	0050	0051	0052	0053	0054	0055	0056	0057	0058	0059	0060	0061	0062	0063
040	0064	0065	0066	0067	0068	0069	0070	0071	0072	0073	0074	0075	0076	0077	0078	0079
050	0080	0081	0082	0083	0084	0085	0086	0087	0088	0089	0090	0091	0092	0093	0094	0095
060	0096	0097	0098	0099	0100	0101	0102	0103	0104	0105	0106	0107	0108	0109	0110	0111
070	0112	0113	0114	0115	0116	0117	0118	0119	0120	0121	0122	0123	0124	0125	0126	0127
080	0128	0129	0130	0131	0132	0133	0134	0135	0136	0137	0138	0139	0140	0141	0142	0143
090	0144	0145	0146	0147	0148	0149	0150	0151	0152	0153	0154	0155	0156	0157	0158	0159
0A0	0160	0161	0162	0163	0164	0165	0166	0167	0168	0169	0170	0171	0172	0173	0174	0175
0B0	0176	0177	0178	0179	0180	0181	0182	0183	0184	0185	0186	0187	0188	0189	0190	0191
0C0	0192	0193	0194	0195	0196	0197	0198	0199	0200	0201	0202	0203	0204	0205	0206	0207
0D0	0208	0209	0210	0211	0212	0213	0214	0215	0216	0217	0218	0219	0220	0221	0222	0223
0E0	0224	0225	0226	0227	0228	0229	0230	0231	0232	0233	0234	0235	0236	0237	0238	0239
0F0	0240	0241	0242	0243	0244	0245	0246	0247	0248	0249	0250	0251	0252	0253	0254	0255
100	0256	0257	0258	0259	0260	0261	0262	0263	0264	0265	0266	0267	0268	0269	0270	0271
110	0272	0273	0274	0275	0276	0277	0278	0279	0280	0281	0282	0283	0284	0285	0286	0287
120	0288	0289	0290	0291	0292	0293	0294	0295	0296	0297	0298	0299	0300	0301	0302	0303
130	0304	0305	0306	0307	0308	0309	0310	0311	0312	0313	0314	0315	0316	0317	0318	0319
140	0320	0321	0322	0323	0324	0325	0326	0327	0328	0329	0330	0331	0332	0333	0334	0335
150	0336	0337	0338	0339	0340	0341	0342	0343	0344	0345	0346	0347	0348	0349	0350	0351
160	0352	0353	0354	0355	0356	0357	0358	0359	0360	0361	0362	0363	0364	0365	0366	0367
170	0368	0369	0370	0371	0372	0373	0374	0375	0376	0377	0378	0379	0380	0381	0382	0383
180	0384	0385	0386	0387	0388	0389	0390	0391	0392	0393	0394	0395	0396	0397	0398	0399
190	0400	0401	0402	0403	0404	0405	0406	0407	0408	0409	0410	0411	0412	0413	0414	0415
1A0	0416	0417	0418	0419	0420	0421	0422	0423	0424	0425	0426	0427	0428	0429	0430	0431
1B0	0432	0433	0434	0435	0436	0437	0438	0439	0440	0441	0442	0443	0444	0445	0446	0447
1C0	0448	0449	0450	0451	0452	0453	0454	0455	0456	0457	0458	0459	0460	0461	0462	0463
1D0	0464	0465	0466	0467	0468	0469	0470	0471	0472	0473	0474	0475	0476	0477	0478	0479
1E0	0480	0481	0482	0483	0484	0485	0486	0487	0488	0489	0490	0491	0492	0493	0494	0495
1F0	0496	0497	0498	0499	0500	0501	0502	0503	0504	0505	0506	0507	0508	0509	0510	0511